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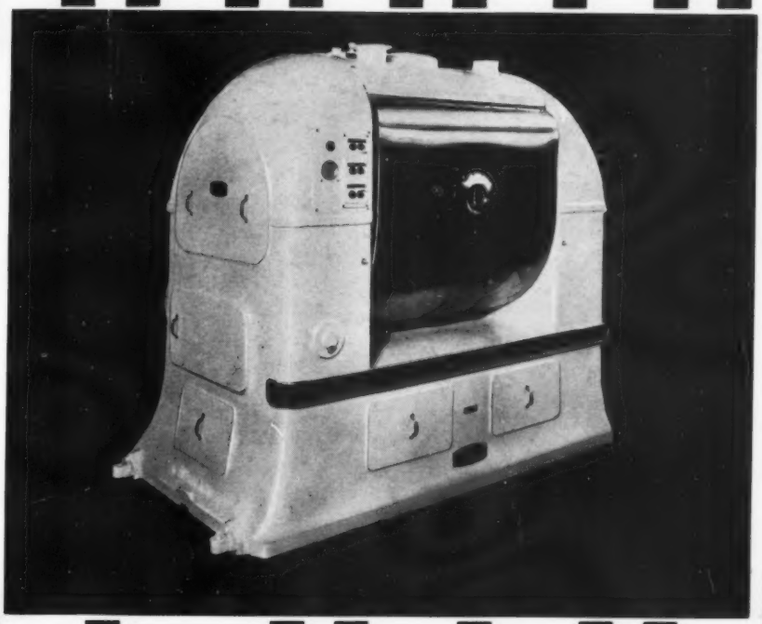
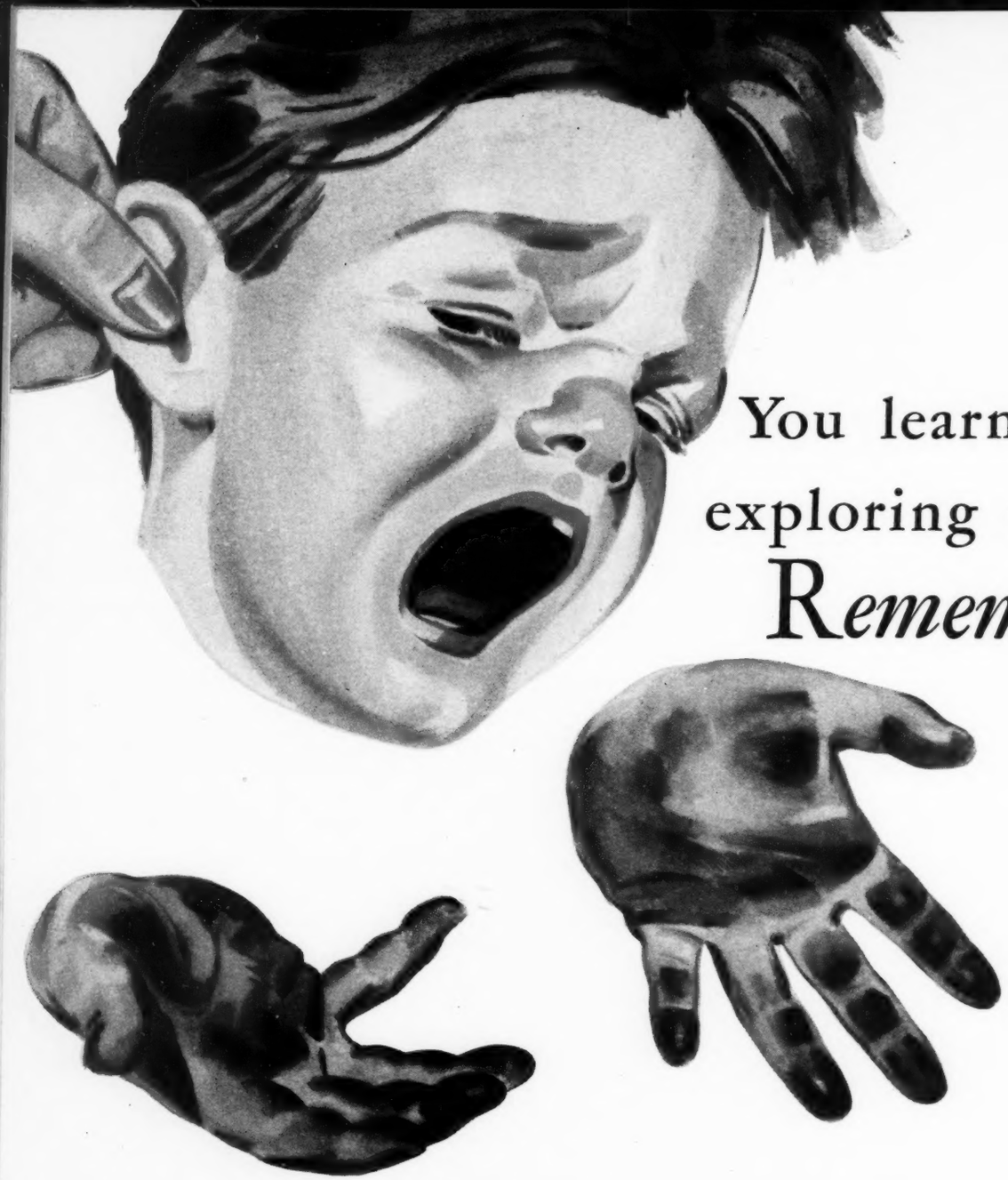
MACHINE DESIGN



as it affects ENGINEERING • PRODUCTION • SALES

In This Issue—
Machine Drives and Controls Supplement

PARTS MATERIALS METHODS FINISHES
OF MACHINES OF EVERY SIZE AND TYPE



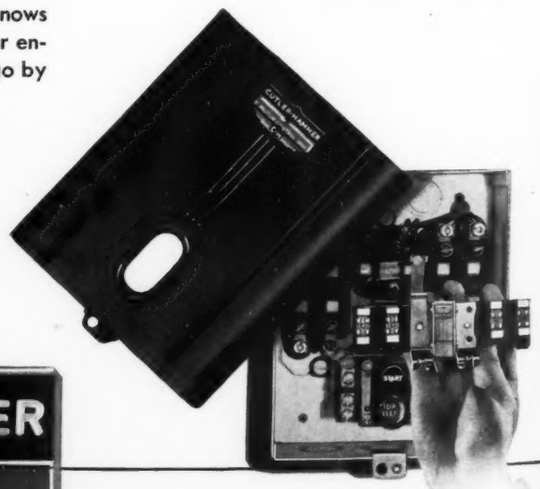
You learned this exploring the attic *Remember?*

IT was years ago when you scrambled up onto old dirty trunks and lifted off the dust-laden lids of curious old boxes . . . remember? And remember your hands, and that clean new white suit . . . and what your good mother had to say about the dust and dirt that lays like a blanket where little boys are not supposed to go?

Well, little boys are not supposed to go inside the Motor Control in your factory today. In fact, your Motor Control should be so good that even those big boys who work with screwdrivers and pliers are supposed to pass that Motor Control by for months at a time without ever putting a finger inside it. And just as your mother said, *there* you will find a blanket of dust . . . dust and dirt in a layer on every *horizontal* surface.

Now that is very bad if the contacts in *your* Motor Control are horizontal, for everyone knows dirty contacts mean trouble. Cutler-Hammer engineers solved that problem a long time ago by designing *their* contacts to stand *vertical* so they can't collect dirt, so they *must* stay clean to *work* better and *last* longer. Cutler-Hammer is the *one* Motor Control that uses *vertical* contacts exclusively.

Don't you think you too should specify Cutler-Hammer and protect your Motor Control investment with good common sense? CUTLER-HAMMER, Inc., *Pioneer Electrical Manufacturers,* 1310 St. Paul Avenue, Milwaukee, Wisconsin.



Insist on CUTLER-HAMMER MOTOR CONTROL C-H *Dust Safe* VERTICAL *Contacts*

MACHINE DESIGN

THE PROFESSIONAL JOURNAL OF CHIEF ENGINEERS AND DESIGNERS

Volume 12 — APRIL 1940 — Number 4

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NEW DEPARTURE
THE *FORGED STEEL* BEARING

MACHINE DESIGN

Knowledge of Mold Construction Improves Plastic Designs

By J. Delmonte

THIS article continues the highly popular series of articles by Mr. Delmonte in MACHINE DESIGN, discussing various phases of plastics as they apply directly to design. A new book by the same author, moreover, has just been published under the title Plastics in Engineering. *It is the first work prepared primarily for the designer, explaining the subject fully and outlining the potentialities and applications of plastics. A detailed review is on Page 50 of this issue*

ACCURATE dimensioning of plastic parts, as well as greater latitude in important design details, are facilitated when a designer has information on the proposed mold construction. Many machine builders always consult with custom molders

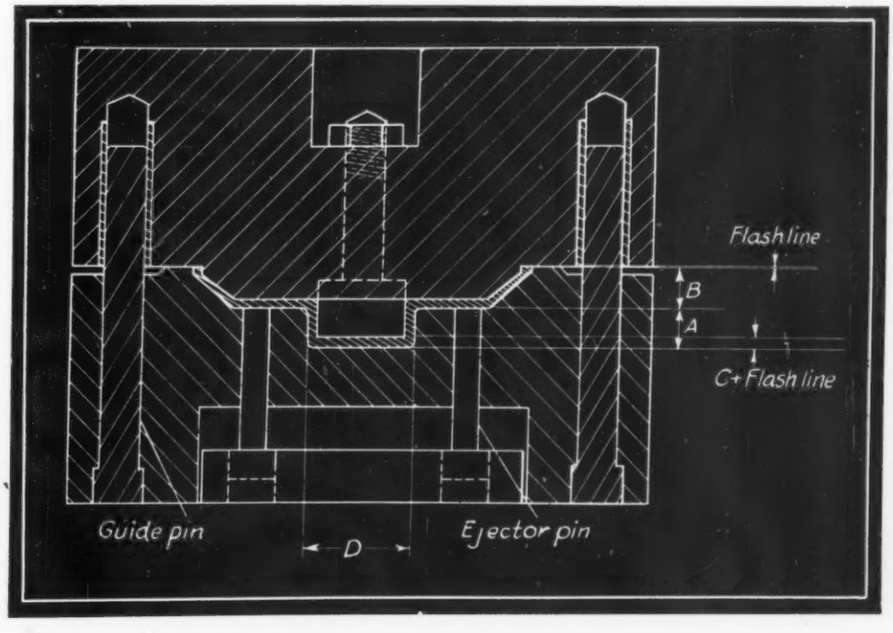

Fig. 1—Molded dimensions formed by the same component of the mold are held as accurately as the component is machined. Hence dimensions A and D will be accurate, B and C dependent on flash line thickness

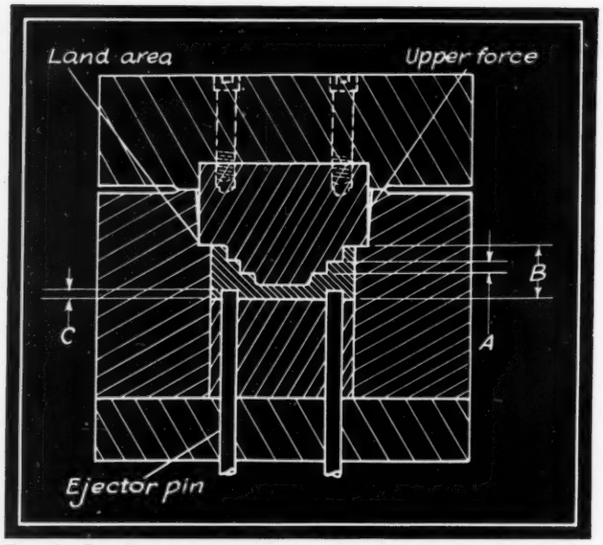

Fig. 2—In this semipositive mold, dimension A will be accurate because it is developed along the same mold component. Other dimensions may vary considerably

on the relationship of the molded parts to the rest of the assembly.

Some of the more common design features directly influenced by mold construction are:

1. Dimensioning of parts and allowable tolerances
2. Draft requirements to permit easy removal from the mold
3. Location of ribs to strengthen parts and improve flow of molding material to isolated parts of the molded piece
4. Accuracy with which special inserts are located in the molded piece
5. Decorative details which are located on the outside surface.

The large majority of production molds are built-up units, formed by individual components such as the chase, upper and lower force, upper and lower pressure plates, coring pins, ejection pins, insert holding pins, pin plate, and guide pins. The chase may be cored for steam or for heat provided by a separate steam plate. Formation of the molded part is actually accomplished by the chase and force plugs which are individually machined components accurately assembled together. Relationships grow more involved if the design requires a split mold and tapered chase.

Flash Thickens as Mold Wears

DIMENSIONING: Generally, those dimensions upon a molded piece which are formed by the same component of the mold construction are held as accurately as that component may be machined. For example, in the flash mold in *Fig.* 1, dimensions *A* and *D* may be expected to be held accurately, while *B* and *C* are dependent upon the thickness of the flash line through which the excess material flows during molding. In new molds this flash may be only .002-inch to .005-inch thick, but as the mold wears after many cycles of operation, the flash will grow steadily thicker up to as much as 1/32-inch. Vertical dimensions such as these may be held quite accurately in transfer and injection molds, which are tightly closed before the material is injected. (For comparison of molding methods see MACHINE DESIGN, *Injection and Compression Molding,* July, 1939, page 29). In the case of these molds the accuracy is dependent to a large measure upon the clamping pressure keeping the individual components of the mold together.

Material Shrinkage Enters Picture

Another example is the widely used semipositive mold in which a flash line is developed at the land area. However, the positive mold dimensions parallel to the direction of molding are dependent upon the accurate measurement of the molding charge which has been introduced into the cavity. In *Fig.* 2, dimension *A* may be accurate because it is developed along the same component of the mold. However, other vertical dimensions from the bottom line or the top may have considerable variation. Likewise the depth of the cored out portion at *C* may vary slightly if knockout pins are used at this location to push out the molded piece.

Further, the designer may have to contend with the shrinkage of the molded material. While this may be readily predicted on simple geometric shapes, and proper allowances made in the mold construc-

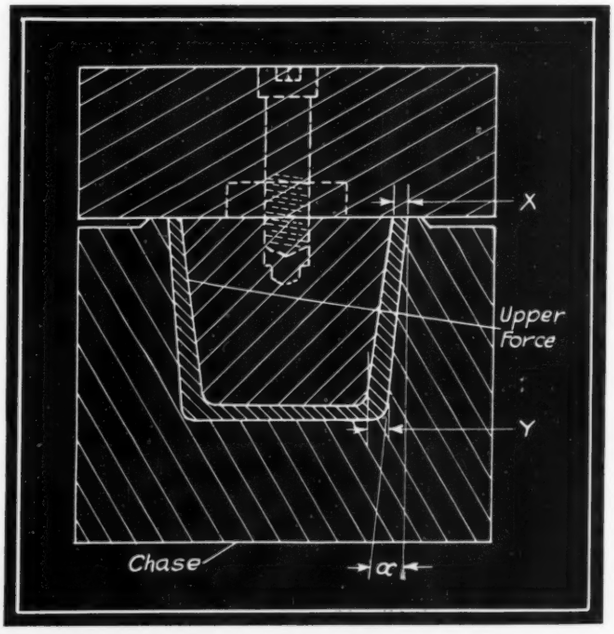

Fig. 3—Draft or taper is determined by the direction the piece is pulled from the mold, hence mold construction determines where allowances for draft must be made. Draft angle is indicated above

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DRAFT: The mold construction will determine where allowances in the design may be made for the draft or taper, because these are determined by which direction the piece is pulled from the mold. In *Fig.* 3, the draft angle is indicated by α.

In many designs such as radio cabinets, a pronounced draft adds to the appearance of the finished piece by giving an illusion of breadth and volume. However, there are many cylindrical housings, for example, which require as little draft as possible, necessitating a closer study of the mold design. Experience has shown that if the piece is withdrawn from a highly polished mold, less draft will be required than if a rough finish is present on the mold surface. For absolute uniformity in dimension and no draft, a split mold would be necessary. This type of mold construction is more costly, however, and the unit charge per piece higher. For general design work on hot molded plastics, a draft of about .005-inch per inch of depth should be satisfactory while about double that value would be necessary for cold molded products, which are less mechanically rigid when ejected from the mold.

Another important design feature included in *Fig.* 3 is dimension *X* at the top as compared to the wall thickness, dimension *Y* at the bottom of the mold. For example, it is much more desirable for hot molded ureas when a considerable depth of flow is involved, to have a decreasing wall thickness in the direction of flow toward the flash line in the mold. In the example just cited, .07-inch may be a suitable dimension for *X* and .1-inch a suitable dimension for *Y*.

RIBS: The dual purpose of ribs, namely to strengthen the molded piece and to improve the flow of material over the article, has long been recognized by the molding industry. Whenever pieces of appreciable size are involved, ribs should be included in the design to attain these benefits. Designs produced in injection molds derive large benefits from this practice, such as indicated in *Fig.* 4 where a path from the injection sprue to the center boss is provided by the rib for the molding material. Obviously in this example, prior knowledge of where the injection sprue is to be placed was necessary before including the ribs in the design.

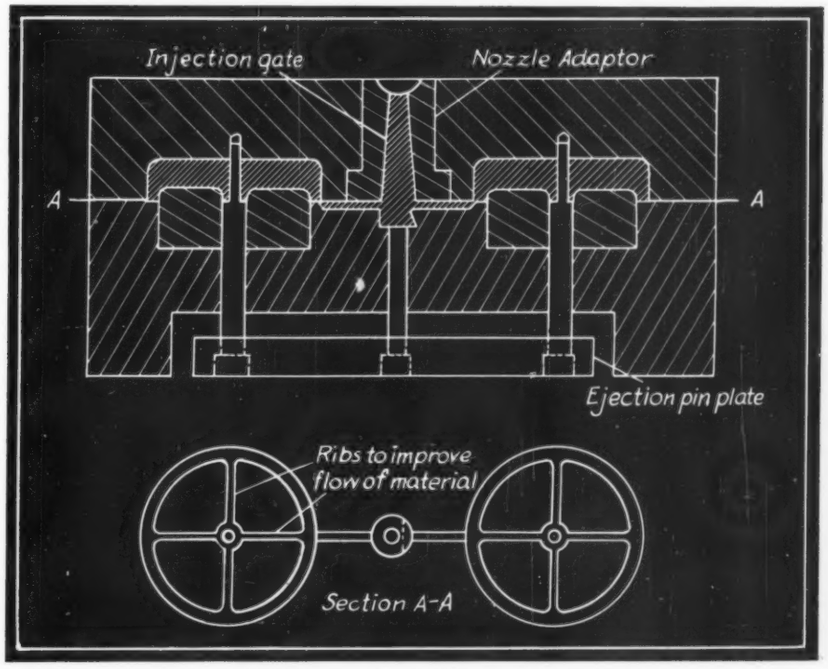


Fig. 4—Ribs strengthen the piece and improve the flow of material over it. Here the rib provides a path from the injection sprue to the center boss for flow of material

Ribs May Be Advantageous

Under some conditions in the molding of phenolics, the location of a small rib at the flash line has certain advantages. It will serve to draw attention away from some joint that is formed when the molded piece is mated to another, and will simplify finishing of the edge to some extent. Anticipation of this condition in the design is possible only when the mold construction is tentatively known.

INSERTS: The great majority of inserts employed in molded plastics can be handled without much difficulty in the mold construction by insert holding pins

or special pin plates in split cavity molds. It is helpful for the designer to know the type of mold, however, inasmuch as some types will permit a greater latitude in the specification of inserts than others. Noteworthy in this respect are transfer molds which will handle unusual inserts of every description. *Fig.* 5 illustrates what appears to be a simple molding problem, in which the molding material is molded around a steel tubing. A diamond knurl upon the outside of the tube provides sufficient anchorage from twisting or pulling out after the piece is molded. In the problem illustrated, however, when an attempt was made to mold about the insert in a semipositive compression mold there was no assurance that the insert would remain fixed in position, as it tended to float away. As the thickness of the insulation over

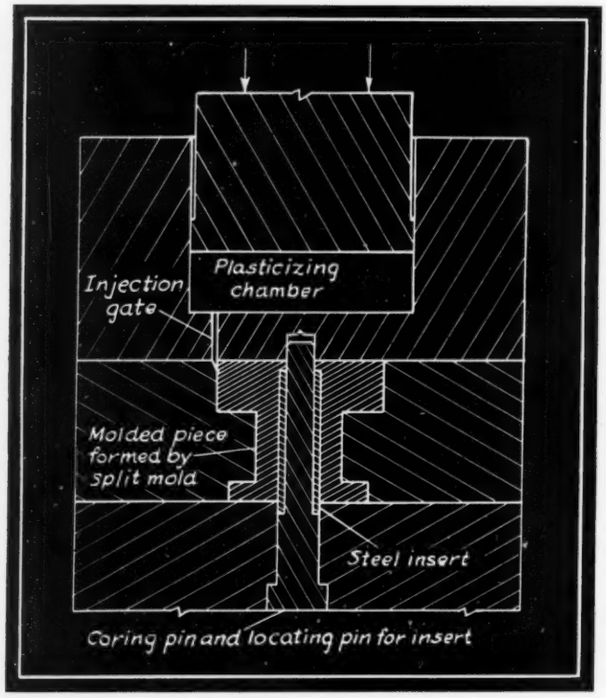


Fig. 5—Transfer molds simplify handling of unusual inserts, as in this case where material is molded around a steel tubing. In a compression mold the insert tended to float away and there was no assurance it would remain

the end of the tube, and the length of the tube projecting from the end of the molded piece were important, special expedients were required, such as small pins from the upper force. More satisfactory results were obtained with a transfer mold, which obviated further changes in the design.

Consequently, it may be pointed out that the accuracy of the location of inserts in relation to the remainder of the molded part is determined to a large measure by the nature of the mold construction. Dimensioning these parts correctly in the complete assembly can only be done through information on the proposed method of molding.

DECORATIVE DETAILS. Name plate data, trademarks, or engravings of some nature are usually inscribed upon a separate portion of the mold construction, where they may be easily replaced if necessary. It is generally good practice to alter the design slightly either to raise or recess the panel carrying the inscription, with respect to the surface of the mold. Otherwise a thin fin will tend to appear at the line of separation between the panel carrying the inscription and the main mold surface. These thin fins which make their appearance at the divisions of the components of the mold in a built-up construction, are not easy finishing problems. It is possible to correct the condition by designing a small step to set off the panel or mold division from the rest of the surface. This is particularly important for mold designs in which the inscription member or panel will serve as an ejection member for the molded article, where a slight misalignment with respect to the main mold surface is probable.

Costly Molds Alter Design

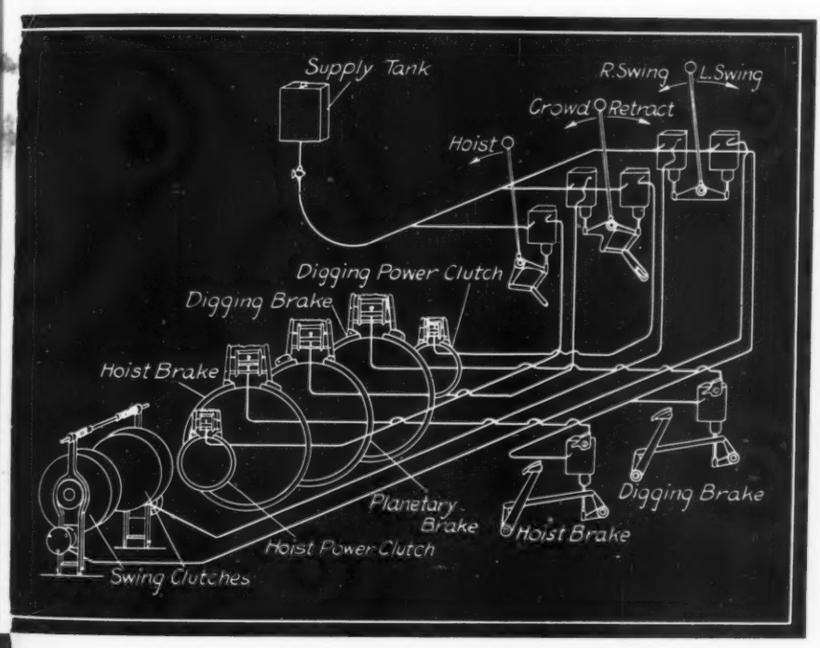
COSTS: Numerous examples exist in which designs have been altered because of costly mold constructions. To cite a very obvious example, a cylindrical motor housing may require two side holes for the provision of lubrication to the bearings. The mold for locating these holes would have to be split, involving a more costly construction and raising the cost of the piece since the length of the molding cycle is increased by the time necessary to assemble and disassemble the split molds. It would be entirely feasible from a design standpoint to remove the side cores from the molded piece and drill them into place at a considerable saving.

Consultation with the custom molder will reveal those features of a design in molded plastics which may entail costly mold constructions and prolong the molding operation. In many cases the machine designer may modify his design to permit the production of a more economical piece.

Examples of mold details and their effects upon the design of molded parts have been cited in this article, to lay emphasis upon the importance of the designer's becoming familiar with the proposed method of molding and mold construction.

Indicative of the rapidly increasing demand for stainless steel was the recent opening of the largest stainless steel finishing department in the world, at Republic Steel Corp.'s Massillon, O., plant. All wings of a five-acre building are occupied by the department. Increasingly diversified uses for stainless presage considerable expansion of production facilities in the future, since the 1939 output was substantially greater than the 85,673 tons produced in 1938. Largest single use for stainless at present is automobile trim, with the railroad industry a strong second.

Scanning the Fields FOR IDEAS



Utilizing standard p proved automotive hydraul units, the Harnischfeger C applied low pressure hydraulic co new excavator. Both clutches an for shovel movements as shown in the diagram are energized by the operato levers or brake pedals. Each functi own master cylinder, the entire syst supplied from a common reservoir lo sufficient height to maintain a full the lines.

There is no loss of efficiency due t or heating of the hydraulic fluid. N joints or stuffing boxes are used. Being units, replacement parts and ser readily available almost anywhere, often of particular importanc

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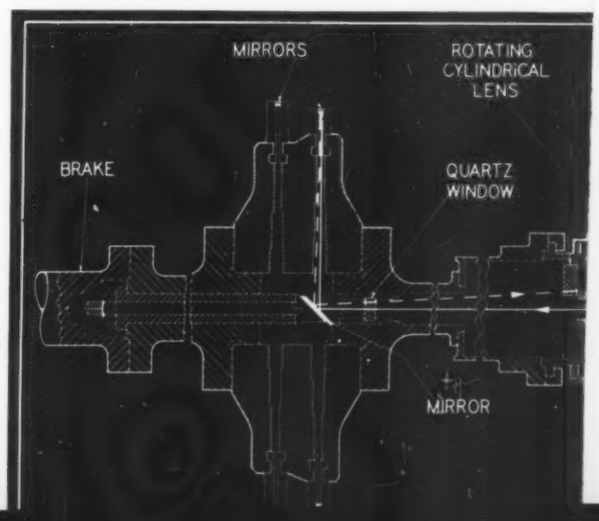
Vibration characteristics of turbine blades may be studied from photographic records made with the optical system illustrated. Developed by Westinghouse Electric and Mfg. Co., this device shows if vibrations are resonant. These studies are important because maximum stress is affected by mechanical resonance and the damping characteristic of the steel. Mechanical resonance is obtained when the shock frequency from the steam jet superimposes the natural frequency of the blade. Damping characteristic is the slowly decreasing amplitude of vibration due to intermolecular friction of the material. Design of blades and choice of material determine these characteristics.

Reference to the illustration shows mirrors mounted inside the blades. A light beam projected through a hole in the turbine shaft is reflected by an inclined mirror to the mirror in the whirling blade being photographed and the out through the shaft to the screen. is so proportioned that blade move magnified 250 times. A typical shows mechanical resonance at steam jet impact with turbine b



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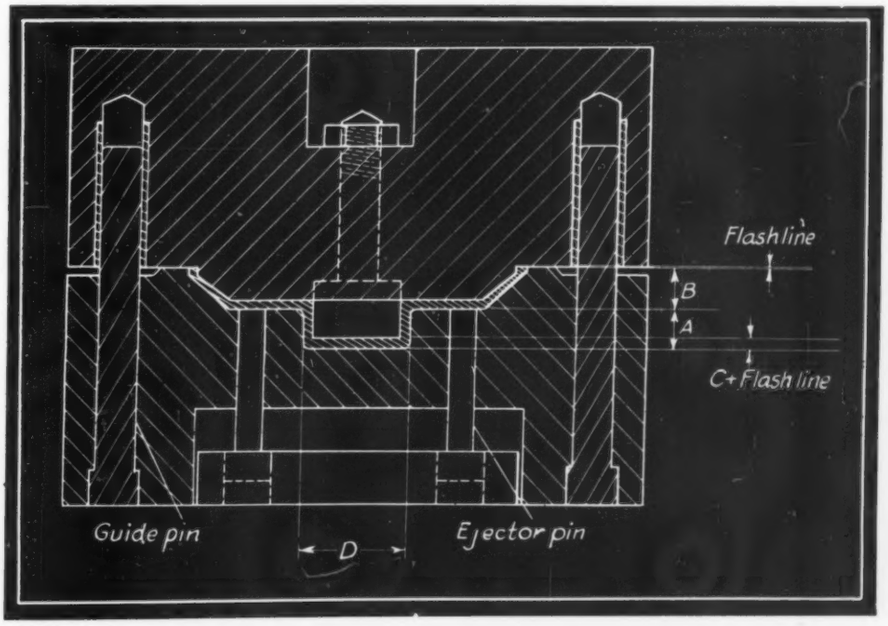

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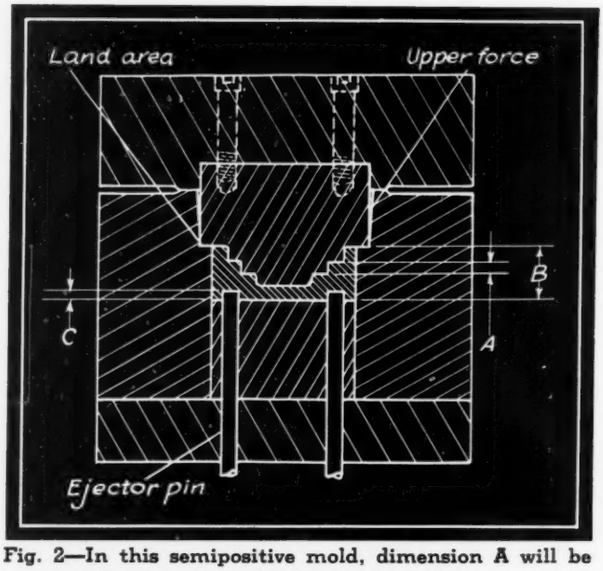

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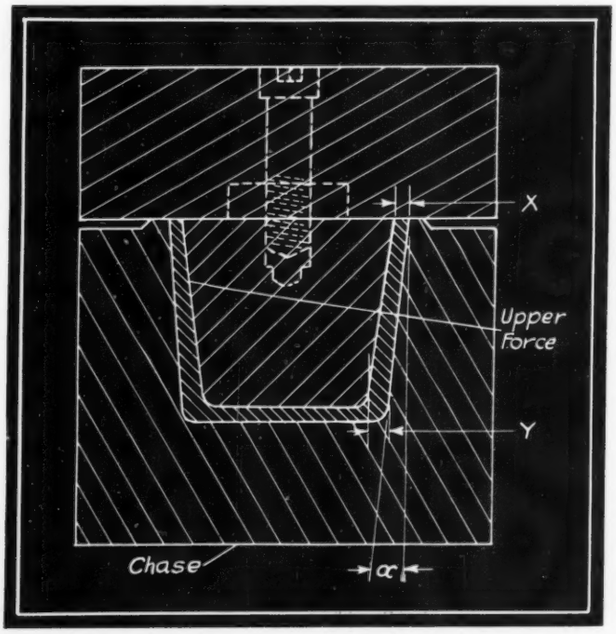

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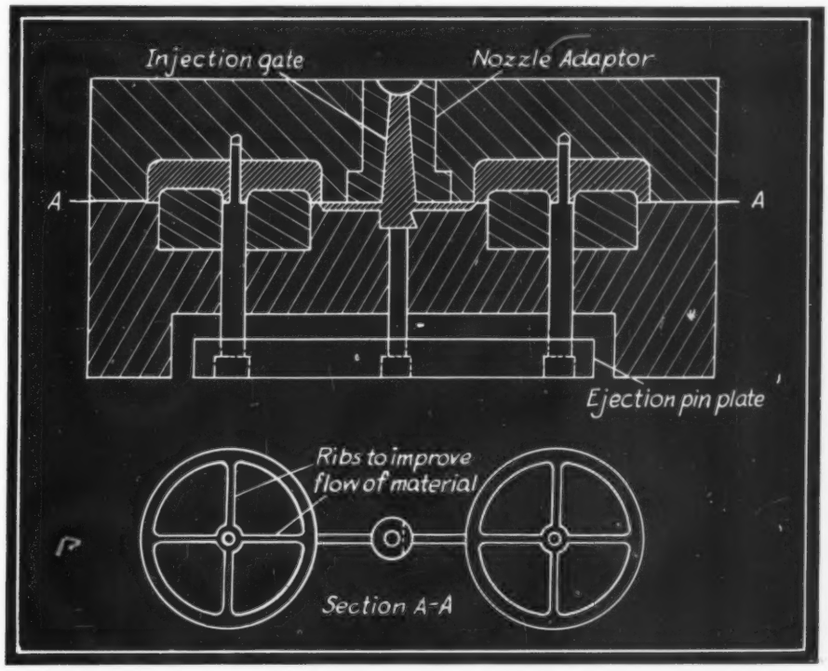

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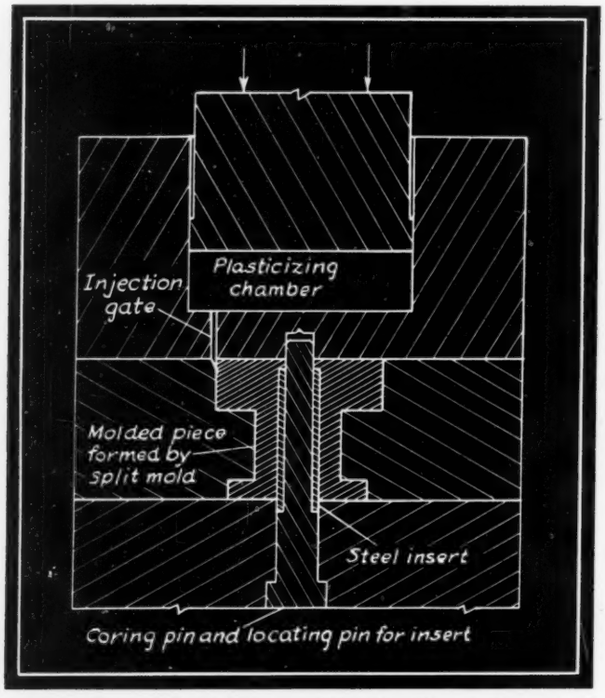

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DECORATIVE DETAILS. Name plate data, trademarks, or engravings of some nature are usually inscribed upon a separate portion of the mold construction, where they may be easily replaced if necessary. It is generally good practice to alter the design slightly either to raise or recess the panel carrying the inscription, with respect to the surface of the mold. Otherwise a thin fin will tend to appear at the line of separation between the panel carrying the inscription and the main mold surface. These thin fins which make their appearance at the divisions of the components of the mold in a built-up construction, are not easy finishing problems. It is possible to correct the condition by designing a small step to set off the panel or mold division from the rest of the surface. This is particularly important for mold designs in which the inscription member or panel will serve as an ejection member for the molded article, where a slight misalignment with respect to the main mold surface is probable.

Costly Molds Alter Design

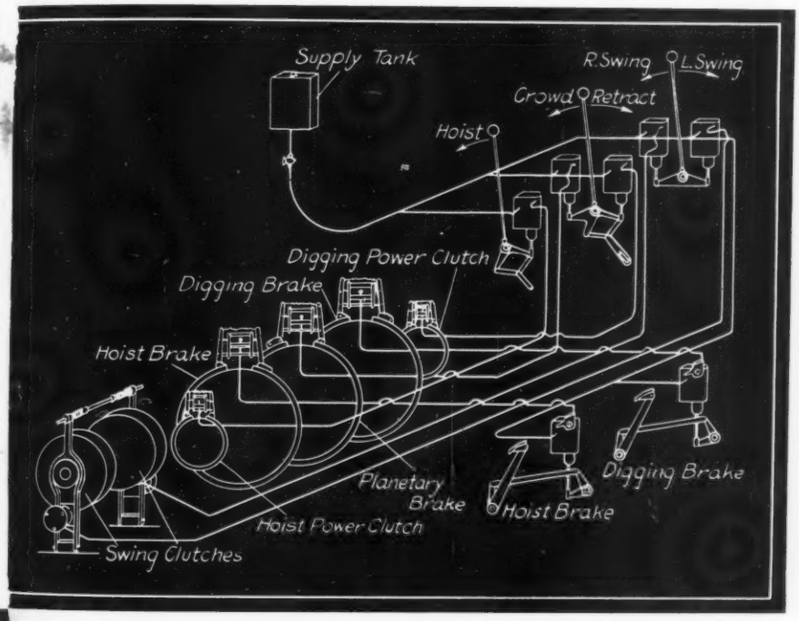
COSTS: Numerous examples exist in which designs have been altered because of costly mold constructions. To cite a very obvious example, a cylindrical motor housing may require two side holes for the provision of lubrication to the bearings. The mold for locating these holes would have to be split, involving a more costly construction and raising the cost of the piece since the length of the molding cycle is increased by the time necessary to assemble and disassemble the split molds. It would be entirely feasible from a design standpoint to remove the side cores from the molded piece and drill them into place at a considerable saving.

Consultation with the custom molder will reveal those features of a design in molded plastics which may entail costly mold constructions and prolong the molding operation. In many cases the machine designer may modify his design to permit the production of a more economical piece.

Examples of mold details and their effects upon the design of molded parts have been cited in this article, to lay emphasis upon the importance of the designer's becoming familiar with the proposed method of molding and mold construction.

Indicative of the rapidly increasing demand for stainless steel was the recent opening of the largest stainless steel finishing department in the world, at Republic Steel Corp.'s Massillon, O., plant. All wings of a five-acre building are occupied by the department. Increasingly diversified uses for stainless presage considerable expansion of production facilities in the future, since the 1939 output was substantially greater than the 85,673 tons produced in 1938. Largest single use for stainless at present is automobile trim, with the railroad industry a strong second.

Scanning the Field For Ideas

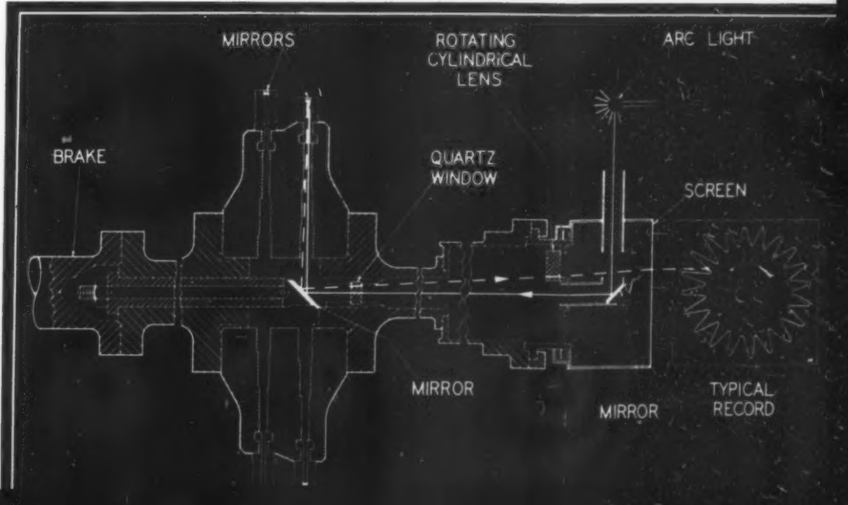


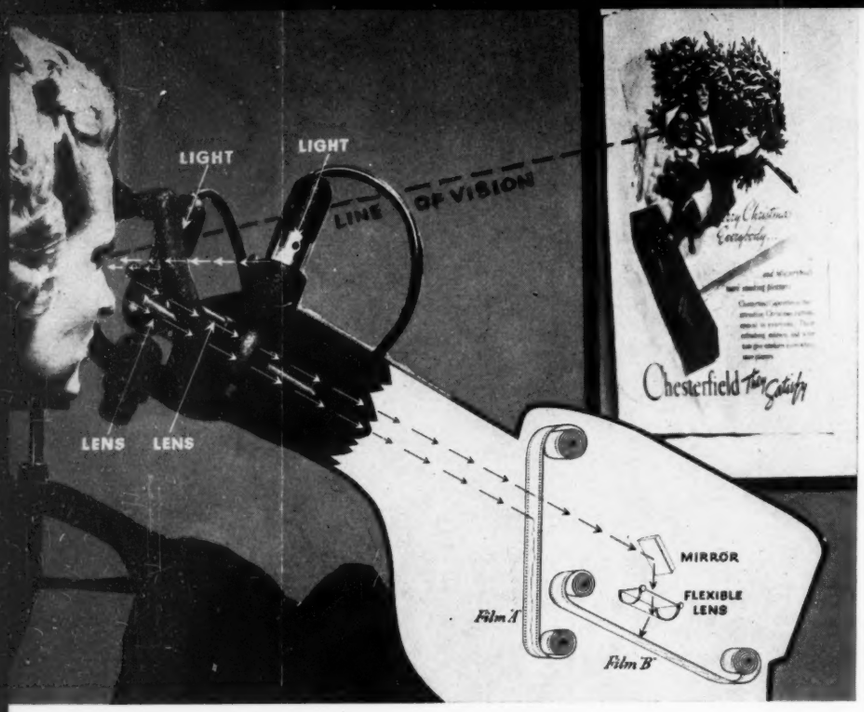
Utilizing standard parts of proved automotive hydraulic brake units, the Harnischfeger Corp. has applied low pressure hydraulic control to a new excavator. Both clutches and brakes for shovel movements as shown in the schematic diagram are energized by the operator's control levers or brake pedals. Each function has its own master cylinder, the entire system being supplied from a common reservoir located at a sufficient height to maintain a full supply in the lines.

There is no loss of efficiency due to foaming or heating of the hydraulic fluid. No rotating joints or stuffing boxes are used. Being standard units, replacement parts and service are readily available almost anywhere, a factor often of particular importance

Vibration characteristics of turbine blades may be studied from photographic records made with the optical system illustrated. Developed by Westinghouse Electric and Mfg. Co., this device shows if vibrations are resonant. These studies are important because maximum stress is affected by mechanical resonance and the damping characteristic of the steel. Mechanical resonance is obtained when the shock frequency from the steam jet superimposes the natural frequency of the blade. Damping characteristic is the slowly decreasing amplitude of vibration due to intermolecular friction of the material. Design of blades and choice of material determine these characteristics.

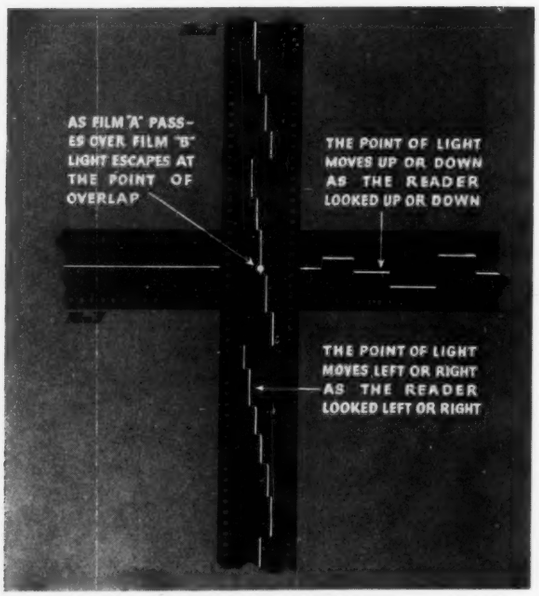
Reference to the illustration shows mirrors mounted inside the blades. A light beam projected through a hole in the turbine shaft is reflected by an inclined mirror to the mirror in the whirling blade being photographed and then back out through the shaft to the screen. System is so proportioned that blade movement is magnified 250 times. A typical record shows mechanical resonance at point of steam jet impact with turbine blade





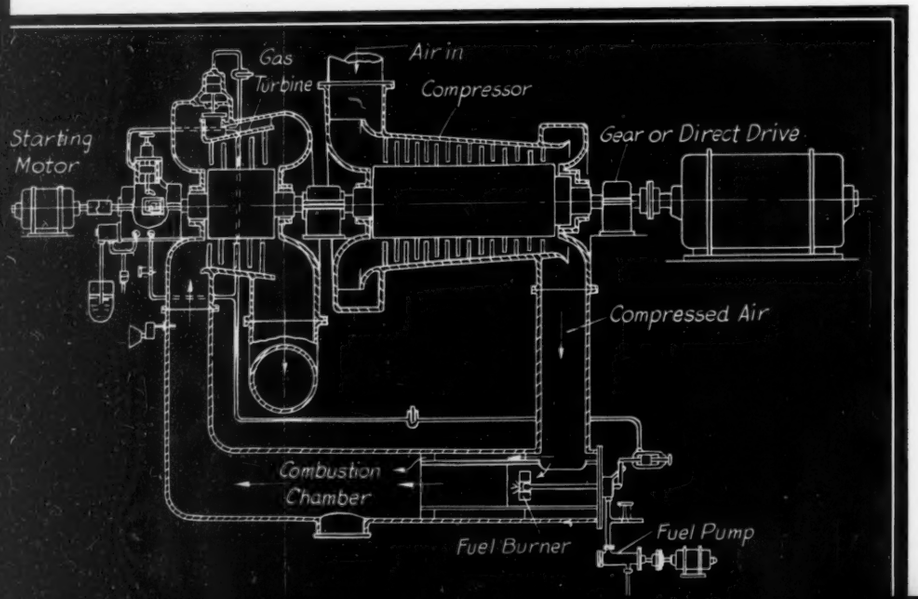
Eye movements can be effectively studied with the Scanacord illustrated. A machine operator's vision habits obtained by this method would be helpful in design and for determining best locations for controls and mechanisms requiring operator-attention.

Using the cornea of the eye as a reflector, a beam of light is projected on sensitized film which moves slowly and thus records the fixations of the eye. One film moves horizontally, recording the action of one eye, and another moves vertically recording the action of the other. When the two films are projected in similar relation, light shines through in a spot showing the eye movements and duration of fixations on each spot. Thus it is possible to tabulate the information required and determine eye attention values. This device was recently demonstrated by Arthur Kudner Inc. for use in conjunction with the Thompson-Luce method of advertising appraisal by studying reading habits



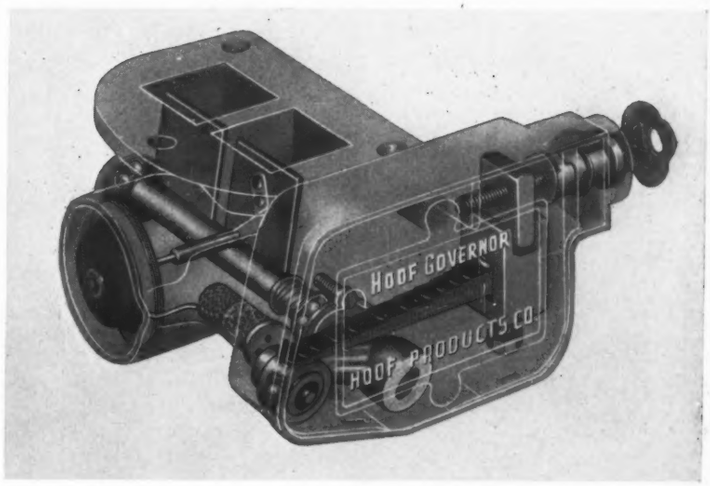
Advantages of direct expansion of combustion products in the combustion turbine include absence of reciprocating parts, no need for boiler or cooling water and simple lubrication problems. Recent improvements in materials and in compressor and turbine efficiencies have made gas turbines practical for many applications including processing equipment and locomotives.

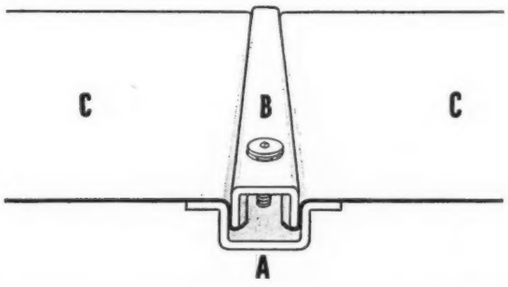
Illustrated is a diagram for an Allis-Chalmers unit. It consists of a gas turbine of a few stages coupled to a compressor which furnishes compressed air to the combustion chamber. There the air is heated and expanded by combustion of the fuel and passes through the turbine, developing sufficient power for use. Present power-weight ratio is about 25 pounds per horsepower with possibility of reduction



Stainless steel shafts, butterfly valves and roller bearing balls reduce the possibility of corrosion and sticking which might alter the calibration of the gasoline engine speed governor illustrated. Designed by Hoof Products Co., this governor is controlled by manifold suction and delivers full power up to its preset maximum speed.

Cantilever spring, factory calibrated to engine characteristics, controls the butterfly valve action as shown. Adjustment of spring block varies the maximum speed allowed by the governor according to position. This position can be changed only by key. Diaphragm operates when part throttle position of the carburetor valve is attempted. Air chamber in housing offers sufficient pressure change for diaphragm without depending on any exposed opening to breathe atmosphere and foreign particles into governor unit





Easily assembled panels are applicable to almost any structure requiring sheet and framing where light weight, strength or portability is desired. The Lindsay structure illustrated, showing a panel being assembled and a joint detail, utilizes the panel sheet for adding rigidity to the structure.

Need for cross braces, gussets and struts are eliminated. The principle, developed by Dry-Zero Corp., employs a flanged frame, a U-member which fits inside the channel of the flanged frame and a panel with turned over edges as shown. Dimensions of parts are so determined that when assembled and frame members drawn tight with socket screws the entire assembly is a rigid, strong unit

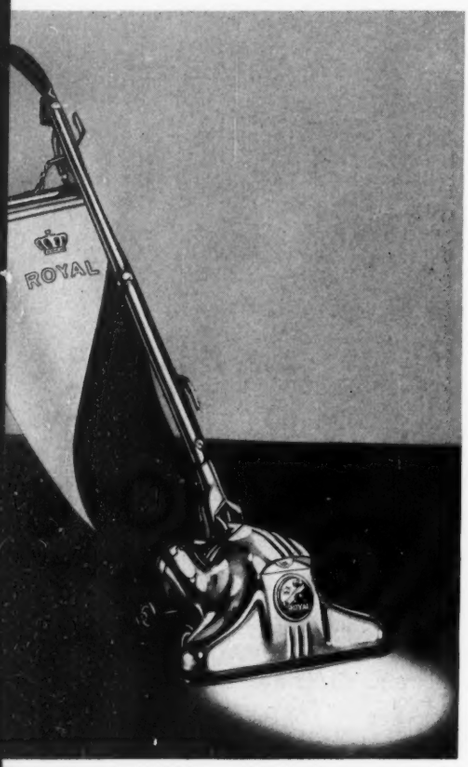


Fig. 1 — Design of domestic equipment involves appearance, weight, dependable operation

Fig. 2—Sectional view shows design details of motor, bearings, fan and revolving brush

Household Cleaner Is Designed for Abuse

By Fred B. Jacobs

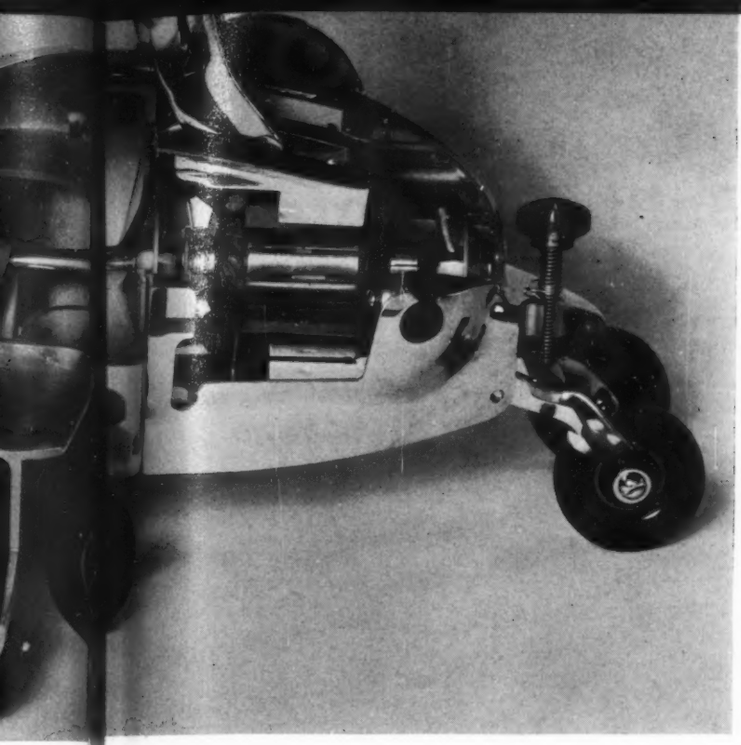
TO DESIGN an efficient vacuum cleaner which successfully meets competition, overcomes sales resistance and satisfies the critical modern American housewife involves consideration of all new developments in materials and mechanisms. In a modern cleaner such as the Royal cleaner, *Fig.* 1, made by the P. A. Geier Co., Cleveland, the motor must deliver the requisite power to maintain the desired suction, function at all times with little or no attention, and be as foolproof as possible.

Shown in the sectional view, *Fig.* 2, is a high-speed, 1/3-horsepower plus, universal type, air-cooled motor. This motor does not differ radically from any fractional horsepower unit of like size and capacity, inasmuch as the general design of such units is well established. However, lubrication of these little motors is a problem in itself because household appliances seldom get the attention they deserve as regards oiling.

To obviate abuse, special oil-less bearings, a mixture of powdered copper, tin and graphite amalgamated rather than alloyed are used. Each bearing in its housing as shown in *Fig.* 5 is surrounded with a wick. This wick and channel, filled with oil, contain sufficient lubricant for approximately 6000 continuous hours of operation, which represent the life of the average vacuum cleaner. However, under some conditions of unusual service additional lubrication is required. For such conditions, the wick which surrounds the bearing terminates in another wick, shown in the illustration, which comes up through a tube so that the bearing can be relubricated should occasion require. The flange in which the bearing housing is located is provided with suitable ribs to insure adequate strength. This unit is a die casting as are many vacuum cleaner components. However, in some instances permanent-mold castings are employed.

Because they cannot be line reamed by methods followed in aligning bearings in popular forms of construction, alignment is assured by providing self-aligning seats. The outer surface of the bearing hous-

Fig. 3—Cap has indicating button attached to diaphragm to signal when suction is sufficient



ing is spherical and is made to fit into a spring metal retainer.

Thus when the motor shaft is assembled the bearings come into alignment automatically. The bearing along with its lubricating system is a self-contained unit. Advantages of construction are simplicity in construction and protection against all leakage.

Diaphragm Indicates Proper Suction

It is essential to adjust the nozzle height for maximum cleaning efficiency on various types of floor coverings. This is accomplished by an adjusting screw shown near rear wheel in *Fig.* 2. To obviate guesswork in adjusting the nozzle, a calibrated rubber diaphragm is employed in the cap on the cleaner nozzle, *Figs.* 3 and 4. When the nozzle is adjusted to the correct height over the surface to be cleaned, the vacuum created in the cleaner housing will bring this rubber diaphragm inward or toward the holes shown in *Fig.* 4. At this position the button in the front of the cap, *Fig.* 3, will be moved inward. This button is fastened to the diaphragm and its inward movement serves as an indicator to show that the nozzle height is correct for effective cleaning.

Two rows of bristles arranged spirally around a drum provide brushing action. The principle involved is that the rapidly revolving rows of bristles lightly tap and sweep the carpet or other material to be cleaned and thus help to dislodge dirt which must be sucked away by the air going into the nozzle, which

Fig. 4—Backside of cap showing holes to actuate diaphragm by sweeper suction

of course must come through the carpet nap. As *Fig.* 2 shows, the brush is driven by a quarter-turn belt, which runs over the pulley shown at the extreme end of the fan hub, which is a continuation of the motor shaft.

The cleaner under discussion is fitted with two sets of wheels, two wheels to each set. Object of this peculiar form of construction is to aid in the cleaning of rugs, especially little rugs with fringes at the edges. When the cleaner is moved forward over the fringe nothing out of the ordinary happens. If the cleaner is moved backwards, however, the fringe may become entangled in the bristles of the revolving brush,

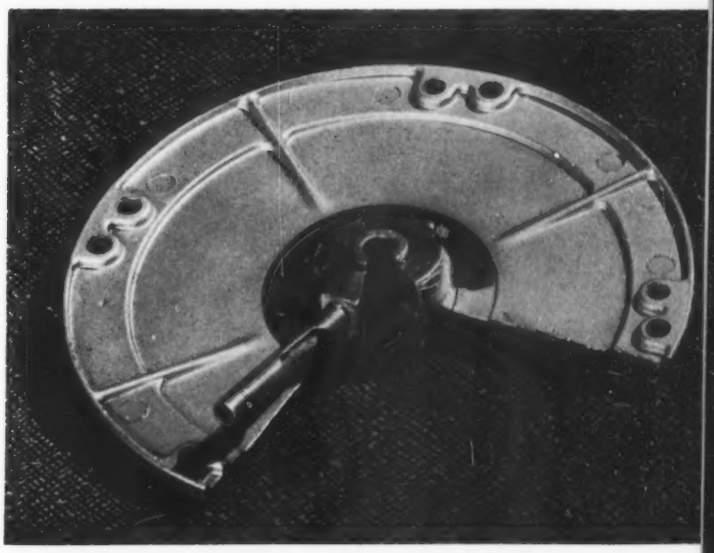


Fig. 5—Oil-less bearings are mounted in self-aligning housing retained in plate by spring clip. Wick may be lubricated if duty requires

Fig. 1, and cause an annoying delay. Thus with two sets of wheels the housewife when bringing the cleaner back for a new stroke after going over the fringe previously mentioned, simply raises the nozzle so that it bears on the two rear wheels only. It can be moved without lifting the cleaner bodily and at the same time with the nozzle away from the rug so that the fringe is not disturbed.

To facilitate cleaning stairs and small rugs, the cleaner handle is fitted with a locking device so that the handle can be held firmly in one position. The locking device also incorporates another feature, by which the handle can be locked in an upright position when the device is stored away in a corner or in a closet.

Incorporated in the handle is a trigger type switch so wired that the entire unit with wiring is removable for ease in assembling and inspection. Baffles take the shock from cord pulls either from motor or lead end. Plastic plugs are utilized for protecting wiring connections, making a strong, well insulated joint.

Fig. 1—Compact design facilitates operation of saw

Built-in Motors Control Interlocks, Increase Utility

By J. Gordon Hartger

Engineer
Oliver Machinery Co.

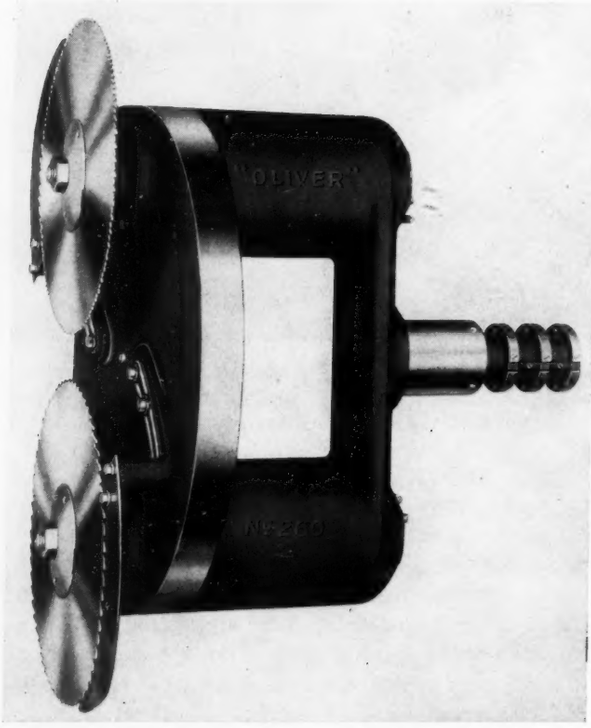
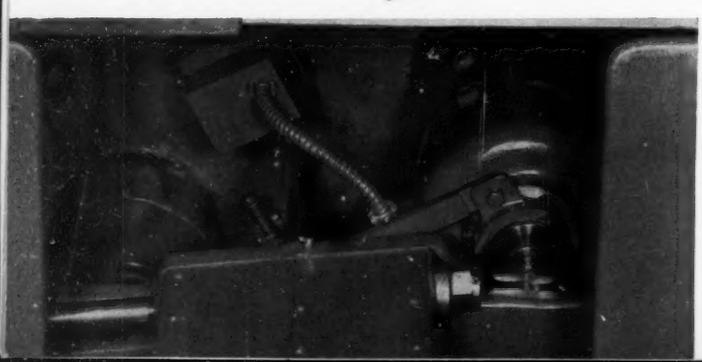


Fig. 2—Control is obtained by split segments on yoke

Fig. 3—Built-in motors with brakes are mounted on revolving yoke, rotated by handwheel through worm and gear



COMPACT, simple arrangements of driving and control mechanisms require a minimum number of parts, usually facilitating operation and reducing maintenance costs. Such features have been embodied in the saw illustrated in *Fig.* 1. Employing a double arbor with built-in shell type motors mounted pivotally on a yoke, quick changeovers between cross cutting and ripping operations are provided. Thus the availability of two saws is combined in one machine.

Requirements demand that only the saw projecting through the table can revolve and that if lowered it must stop automatically. This is accomplished through electrical controls and interlocks. A centrally located insulated tube supports six segments, shown in *Fig.* 2, which carry the electrical power to the preselected motor and provide interlocking.

External control for the entire saw has been condensed to one start and one stop button, the latter shutting off the current as well as applying an electric brake. This brake is also applied automatically when the saw is lowered below the table.

Yoke is rotated by a handwheel with worm and gear. Position of yoke determines whether power or brake is applied through the interlocking features of the split segments. In *Fig.* 3 is shown the yoke mounting and electric brake.

Saw arbor yoke is a one piece casting supporting the two saw arbors and built-in motors. Front end is held by a finished disk bearing; rear end is held in a shoulder bearing. End motion is prevented by the worm gear securely bolted to the outer end of the shoulder bearing, thus locking the yoke to the frame.

Belts, pulleys, idlers, shafts, etc. are entirely eliminated by using shell type motors, built in the two ball bearing saw arbors. This arrangement facilitates the drive methods and permits a compact self-contained unit readily protected by interlocking.

Photoelastic Analysis in Commercial Practice

By R. E. Orton
Acme Steel Co.

Part II

AN UNDERSTANDING of elastic theory and boundary stresses is necessary for the interpretation of photoelastic data and is necessary to complete the discussion of theory published in Part I. Part II, then, will be confined to a discussion of the elements of elastic theory and boundary stresses as well as apparatus for studying stresses. Subsequent issues will treat stress models, their interpretation, technique and applications.

Elasticity theory recognizes that the principal stresses, S_1, S_2, or their normal components in X or Y directions, S_x, S_y, and the shearing components of stress, v_{xy}, v_{yx}, are sufficient to determine the state of stress at any point in a body under plain stress. Three conditions may be set up which, in the usual case, will be sufficient to determine their variation throughout the body, establishing the stress distribution.

One of these three conditions is that obtaining at the boundary of a body. An elemental prism with one face in the boundary must be in a state of balance with the stresses exerted upon it and the forces applied to the exposed face. That is, the stress system must continue out into the loads applied at the boundary. If there is a pressure along the boundary equal to q pounds per square inch, there must be a compressive stress along the boundary equal to q. If there is a friction load equal to v, there must be a shear stress equal to v.

Of course, the deformation of the boundary must not be sufficient to affect appreciably the assumed distribution. For example, it may not be justifiable to consider a load applied by a roller as concentrated. The deformation of roller and body will distribute the load over some area, appreciably changing the stress adjacent to the roller.

The second condition is derived from the static equilibrium of an elemental prism located within the body. It is predicated upon the assumption that the stress varies continuously. That is, there cannot be an abrupt change in the stress between two adjacent points within the body. The stress upon one face will be different from that upon the opposite by an amount equal to the rate of change of the stress times the distance between the faces. Since the rate of change is equal to the derivative, the summation of the forces in the two right angle directions will give two stress differential equations.

The third condition is predicated upon the assumption of a continuous distribution of the strain just as the second was predicated upon the continuous distribution of the stress. By means of Hooke's law expressing the relationship between stress and strain, the derived strain equations may be converted to differential equations between the normal stresses, S_x and S_y.

Theory Based on Perfect Elasticity

The problem then, is to find from the equilibrium equations a stress distribution that will balance the forces applied to the boundary and be compatible with the concept of a continuous variation in the strain.

If a body force is present, i. e., its own weight, centrifugal or acceleration forces, etc., this will appear in the summation to obtain the second condition, and therefore, by substitution, in the compatibility equations. Examination of these equations discloses that, where the body forces are constant, the elastic constants are not involved in the stress distribution. This would be the case where the only body force is its own weight. Since the elastic constants of bakelite, and other materials used for models are usually different from the materials used in the actual parts, this justifies the carry over from the stress distribution found in the model to the actual part. It should also be noted that with con-

stant body forces the stress distribution is the same for plane deformation as for plane stress. This means that a case of stress of this kind, e. g., a long roller uniformly loaded, may be analyzed by making the model a thin slice of the part.

Elastic theory is naturally based upon the assumption of perfect elasticity. Model material is very nearly perfectly elastic and therefore, very close agreement is found with the stresses as determined mathematically. Most engineering materials, however are not perfectly elastic. Therefore, departures are found from the stress determined by experimental or mathematical elastic theory, from that obtaining in the piece itself. In some cases this departure may be considerable. However, it always reduces the stress, and therefore the elastic figure lies on the safe side.

General Assumptions Are Justified

Perfect homogeneity of engineering materials is also assumed. This means that, any particle selected at random, will be exactly identical to every other particle. In actual practice there are many important departures, such as inclusions, variations in grain size, etc. These discontinuities cause stress increases just as an external notch is a "stress raiser"; and their effect locally should not be ignored.

Isotropy (absence of directional qualities) is a third assumption. Departures from this are apparent in the crystalline structure of metals, the flow

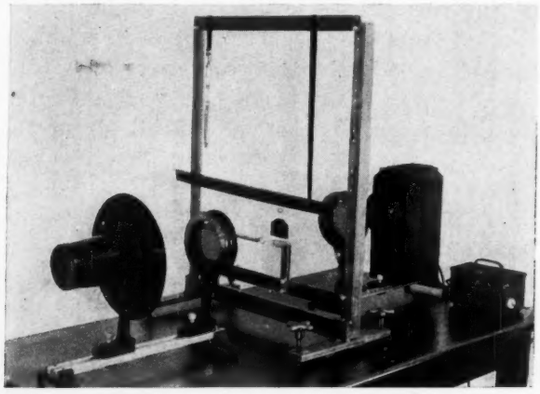


Fig. 10—Polariscope and straining frame for photoelastic studies of stress analysis

lines of forgings, the "fibrous" structure of wrought iron, etc. This defect may also, at times, assume considerable importance.

With these thoughts in mind, there appears no need to carry the stress analysis to the ultimate of refinement and accuracy. Recognition of this will permit of many short cuts in the technique.

The above defects of elasticity, homogeneity, and isotropy should not, however, be considered as a bar to analysis in general. They are local defects, usually confined to the individual crystal or a small group of crystals. But we are not dealing with single crystals; but rather with millions of them. Even in very small particles the random orientation and distribution is such that we meet, in all directions, with an average of a multitude of crystals. Statistically we are justified in our assumption of a perfect material for the original analysis. We may then consider the effect of these variations as a highly local superposition upon the main stress system.

Equivalent Loading Is Required

Saint-Venant's principle, drawn also from elastic theory, is another point of importance to photoelastic analysis. This principle states that, at a distance remote from the application of a load, the stress distribution is independent of the method of application. To illustrate: If a loading be applied centrally to a member in tension the stress distribution will be uniform whether it be applied by one concentrated load, by several concentrated loads symmetrically placed, or a uniformly distributed load; provided that, the point at which the stress is being considered is "remote" from the point of application of the load. Defining "remote" quantitatively is a matter of how accurately the stress is required. In commercial work this certainly need not be more than the greatest lateral dimension away from the application. The accuracy will, in most cases, be within 10 to 15 per cent if only one-half this distance away.

Experimentally it is very difficult to exactly reproduce in the model the actual loading. So long as the stress adjacent to the point of application is not required, it does not matter. All that is necessary is to secure an equivalent system of loading. A classical example is that of the cantilever beam with a concentrated load at its end. Theory calls for a parabolic distribution of the concentrated force, a condition that rarely, if ever, obtains. Nevertheless, it can be shown that, within the beam depth away from the load the vertical shear stress is substantially parabolic, and therefore independent of the arrangement at the end. Of course, if the stress is required at say, one-fourth the depth away, the true method of applying the load must be reproduced.

Failure Begins at Boundary

It has been demonstrated that photoelastic analysis makes possible the determination of the difference of the principal stresses, and the stress directions, at any point. In order to determine the actual stress distribution some other relationship between S_1 and S_2 must be determined. Various methods have been developed for determining their sum. While these methods are quite ingenious, they all require considerable skill, and an amount of time that is out of question for

the usual commercial analysis. Therefore, the determination of the stress distribution *within* the body is not feasible.

However, it is a fact that most failures begin at a point on a boundary, either an external one, or an internal one, such as a hole. Some authorities even maintain that failure never begins within a body. There are two good reasons to believe this besides actual observations of failures. First, the maximum stress is almost invariably at the boundary. Second, due to the discontinuity of structure generally existing at the boundary, stress raisers are present to form a nucleus for the start of failure. Contact stress probably gives the only case of failure beginning from within. Here the stress is so localized that it is possible to estimate its effect from assumed conditions of mathematical theory, and superimpose on the main picture. Practically then, all that is required is the stress distribution along the boundary; and this can be determined from photoelastic analysis.

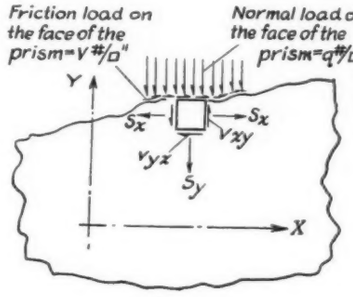


Fig. 11 — General condition of loading and stress of elemental prism having one face in boundary. Loadings on boundary face are the limiting values as prism dimensions become infinitesimal

The general condition of stress at a boundary is produced by an inclined distributed load. This reduces to normal and tangential forces. *Fig.* 11 illustrates an elemental prism having one face in the boundary, loaded in such a manner by a normal force of intensity q and a tangential of intensity v. The coordinate axis X is taken parallel to the boundary at the point under consideration. Note that

$$S_y = -q \quad \ldots\ldots (7)$$

and

$$v_{xy} = v \quad \ldots\ldots (8)$$

Opposite directions of q and v from those shown in *Fig.* 11 are negative. From the photoelastic analysis the quantity Q, the principal stress difference, S_1-S_2, is determined. *Fig.* 12 shows the two possible Mohr's circle diagrams that may be obtained from these conditions. From this figure are derived the following expressions:

$$\sin 2\alpha = \frac{2v_{xy}}{Q} = \frac{2v}{Q} \quad \ldots\ldots (9)$$

$$S_1 = S_y + \frac{1}{2}Q(1+\cos 2\alpha)$$

$$= -q + \frac{1}{2}Q(1+\cos 2\alpha) \quad \ldots\ldots (10)$$

$$S_2 = S_y - \frac{1}{2}Q(1-\cos 2\alpha)$$

$$= -q - \frac{1}{2}Q(1-\cos 2\alpha) \quad \ldots\ldots (11)$$

where α is, as before, the inclination of the S_1 principal stress, (the maximum algebraically), to the X axis. Note that the angle 2α may lie in the first or second quadrant if v is positive, in the fourth or third if v is negative. Therefore α will be positive if v is positive and negative when v is negative. Note also that the two solutions for 2α, (for a given value of v) gives two values of α, the one complementary to the other; and two corresponding sets of values of S_1 and S_2. These two sets of values of angle and stress correspond to the two solutions of *Fig.* 12.

Where it is not obvious which of the two solutions is the correct one the stress inclination may be determined with the plane polariscope. Load is altered until the point in question is at maximum brightness and then the quarter wave plates are swung out of position. Polarizer and analyzer are rotated together until maximum darkness of this point is reached. The inclination of the polarizer will be a principal direction, giving the correct value of α.

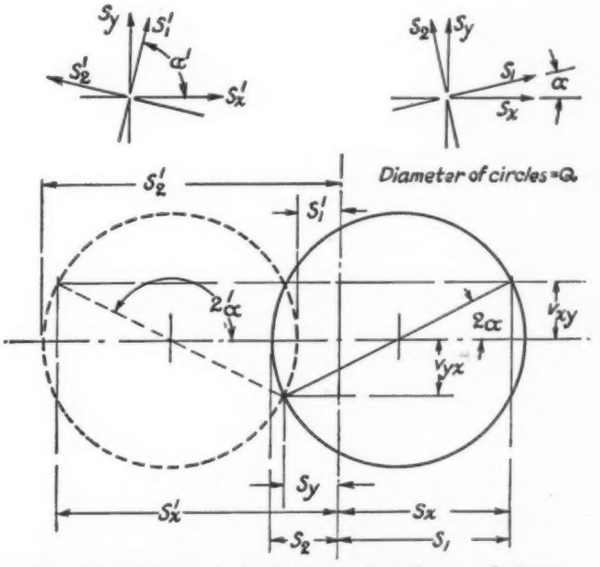


Fig. 12—Mohr's circle diagram for the conditions shown in Fig. 11

If the load is entirely normal to the boundary, v equals zero and the equations reduce to

$$\sin 2\alpha = 0, \therefore \alpha = 0° \text{ or } 90° \quad \ldots\ldots (12)$$

$$S_1 = -q+Q \text{ or } -q \quad \ldots\ldots (13)$$

$$S_2 = -q \text{ or } -q-Q \quad \ldots\ldots (14)$$

or, in terms of the X and Y directions only

$$S_x = -q \pm Q \quad \ldots\ldots (15)$$

$$S_y = -q \quad \ldots\ldots (16)$$

With no load at all the point is on a "free" boundary

(*Continued on Page* 74)

The Iron Lung—Dependability Plus!

FEW if any machines must be as absolutely dependable as the famed Iron Lung, and almost entirely that dependability rests on the driving mechanism. Continuous operation may be demanded for weeks or months. Factors which contribute to dependability include simplicity, sturdiness and ease of servicing if necessary. In addition, the manufacturer, Warren E. Collins Inc., Boston, found quietness so essential that many drive parts had to be specially built.

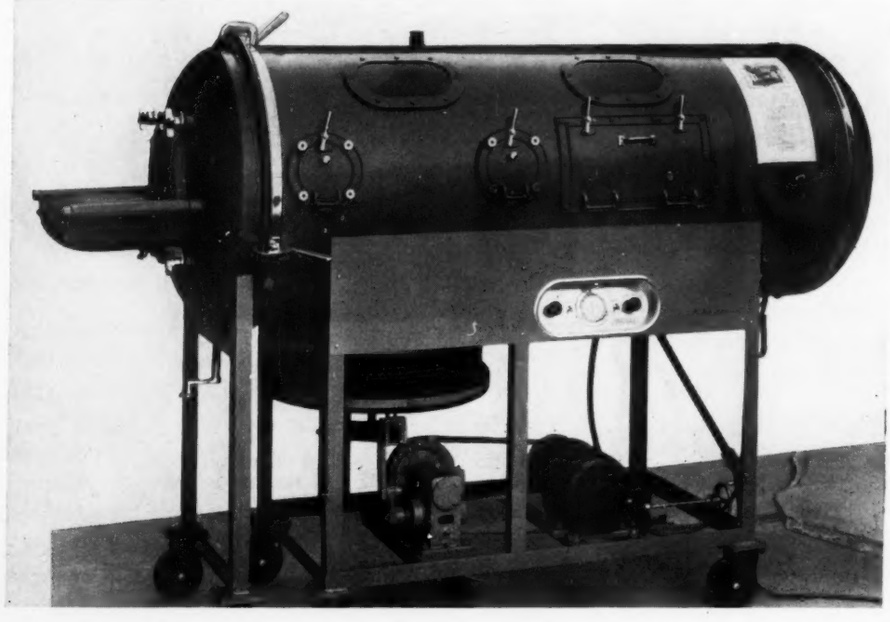
Function of the mechanism is to produce, at rates varying from about 14 to 28 cycles a minute, an intermittent reduction of the air pressure within the steel chamber, to a point governable between 2 and 3 per cent of an atmosphere, on the average. Stated another way, an average working negative pressure of 20 to 30 centimeters of water must be produced. This intermittent negative pressure alternates with atmospheric pressure, positive pressure being rare.

The paralyzed chest of the patient, who may be suffering from illnesses like infantile paralysis, gas poisoning or electric shock, is gently lifted by reduced pressure, causing inhalation. When the pressure returns to atmospheric, passive exhalation takes place.

Changes in pressure are created by the bellows at the bottom which is an extension of the chamber and communicates with it. The bellows has as its flexible member an accordion type specially molded rubber diaphragm. Head of the bellows is actuated through a fixed stem from one of two parallel lever arms, the other being connected through a connecting rod to the crank of the worm reduction gear. In ordinary operation, the lever arms are connected by a box clamp which can be loosened to permit the arms to be disconnected when manual operation is desired. All moving parts in the lever mechanism are provided with needle bearings, except the crankpin, where a 2-row, self-aligning ball bearing is fitted.

The problem of quietness was particularly pressing in connection with the 54 to 1 gear reduction, which had to be made to the company's specifications. Special features include very close fitting of the worm and gear to avoid backlash when the crank passes over center on the suction stroke.

A spring-loaded split pulley, also specially built for quietness, is part of the 2 to 1 variable speed, V-belt drive. Adjustment of the speed is made by moving the motor on its sliding base toward or away from the gear unit. The motor used is a ¼-horsepower repulsion start, induction motor. The controls consist of light and motor switches, precision pressure gage and control knobs for suction and pressure. These are grouped on an attractive, lighted, recessed panel; speed control is at the motor base.



Continuous operation may be demanded of the Iron Lung for weeks or months. Quietness is also needed, and is attained through a special speed reducer and spring-loaded split pulley

MACHINE DESIGN

Editorial

Taxes on Machines Would Be Ruinous

MORE about taxes on machines! Of all the incredible ideas that have arisen to set back the world's most progressive nation, this constitutes a new high. Compared with increased taxation in general—which under certain circumstances is a necessary evil—the suggestion to tax machines and machine production makes the blood run hot and arouses misgivings as to where we are headed.

This time it is one of our better known senators, J. C. O'Mahoney, who brings the subject into the limelight. A bill has been submitted to congress which would have the effect of rewarding those employers whose output is secured by the more-than-average use of manpower, and penalizing by contribution those employers whose plants are mechanized.

One of the most potent arguments against such procedure is that it is a well-established fact that those industries which are the most highly mechanized (classic example being the automobile industry) are by far the most progressive in growth, employ the highest number of men, pay the highest wages, and contribute most toward raising the standard of living. Furthermore, by the very fact of going ahead and making money as well as distributing it, these industries are already amply footing their share of the nation's tax bill.

Perhaps even more to the point is to try to imagine the public paying tribute to a group of manufacturers who, following the implied suggestion in the bill to escape taxation, allowed their methods to become so backward and costly that the public would have to pay through the nose for the privilege of buying high-priced commodities. They not only wouldn't but couldn't buy them . . . . industry would suffer . . . . in turn, so would the public. The whole thing doesn't make sense!

Machine Drives and Controls

READERS will recognize an old friend in the annual Machine Drives and Controls Supplement opposite this page. In its fourth edition it contains the latest available information on drive and control methods put together in such a way as to be of real help to chief engineers and designers.

With the supplement stitched as an individual unit and bound into the center of the book proper, the two can be separated without damage to either, thus adding to convenience in filing for reference.

Men of Machines

P. A. ABE

NEWLY-ELECTED vice president in charge of engineering and production of the Monarch Machine Tool Co., Sidney, O., P. A. Abe has come up through the ranks during his 25 years with the company. Starting as a lathe operator with the Monarch company in 1915, this after having served as a machinist apprentice in the plant of St. Marys Engine Co., he served in the capacities of toolmaker, tool room foreman, general foreman, superintendent and works manager. Three years ago he was elected to the board of directors. Development and adoption of many important lathe design improvements were made under the direction of Mr. Abe. Some of these are the use of helical gears in lathe headstocks, tapered roller bearings on spindle mountings, automatic force feed lubrication for bed ways, carriage and apron bearings, and flame hardening of cast iron bed ways—and last but not least, the "clean-lined" appearance of the company's machine tools.

JOHN MERCK

RECENTLY appointed to the post of chief engineer of Joy Mfg. Co., John Merck was formerly chief designer and assistant chief engineer. Receiving his degree in mechanical engineering in his native Norway, Mr. Merck came to the United States in 1920 and joined the engineering staff in Charleroi Iron Works. A year later he became associated with Mac-Beth-Evans, which he left to join Sutton-Abramson Engineering Co. In 1923 Mr. Merck became connected with John Machine Co. in its engineering department at Evansville, Ind., and the following year was moved to Franklin, Pa., with the company, which was subsequently reorganized as Joy Mfg. Co. Mr. Merck later was sent to England to aid an organization for the manufacture and sale of Joy loaders in Europe. Here he spent a year introducing and developing designs to fit European mining systems and methods. He then returned to the company in the position he held previous to his present appointment.

S. E. LAUER

A RECOGNIZED leader in the field of air conditioning, Stewart E. Lauer rightfully becomes president of York Ice Machinery Corp. Born in York, Pa., Mr. Lauer immediately upon his graduation from the University of Pennsylvania with a mechanical engineering degree, joined the York organization and has now been associated with the company approximately thirty years. While attending college he worked during the summers in the drafting department of the company, and started regular work with the concern in 1911. After being employed in the shop and on the road erecting machinery for the company for several years, he was placed in the research and testing laboratories. Having obtained an engineering background, he entered the sales department. In 1918 he was made sales manager, and five years later Pacific coast manager, where he remained until the merger of the York Mfg. Co. into the York Ice Ma-

chinery Corp. At this time he returned East as assistant to Thomas Shipley, remaining in this capacity until Shipley's death. Mr. Lauer also served as general sales manager previous to his present appointment as vice president in charge of sales. As vice president of the Air Conditioning Manufacturers' association, Mr. Lauer utilizes his broad knowledge in this industry.

*

JULES OLIVIER has recently been named head of the styling division of the Cadillac-LaSalle company.

*

DONALD C. BAKEWELL was recently elected president of the Steel Founders' Society of America, Cleveland, at a meeting of the board of directors. Mr. Bakewell is vice president of Union Steel Castings division of Blaw-Knox Co., Pittsburgh. ARTHUR K. READING, vice president of Zimmerman Steel Co., Bettendorf, Ia., was elected vice president.

*

JOSEPH KAYE WOOD, after temporary association with Grinnell Co. Inc., Providence, R. I., and the Babcock & Wilcox Co., Ltd., London, for a period of three years, is resuming active duty as chief engineer of General Spring Corp., New York.

*

DR. EDWARD RAY WEIDLEIN, director of Mellon institute, Pittsburgh, will be given the Pittsburgh award of the American Chemical Society in recognition of his high professional achievements as an industrial research director.

*

JAMES A. WRIGHT has been elected for his fifteenth term as president of the American Motorcycle association and the Motorcycle and Allied Trades association. Mr. Wright is connected with the Indian Motorcycle Co.

*

GREGORY J. COMSTOCK has been named associate professor of powder metallurgy at Stevens Institute of Technology, Hoboken, N. J. As assistant professor will be CLAIR W. BALKE.

*

D. P. DAVIES, vice president in charge of tractor engineering, has been appointed vice president and consulting engineer with supervision of the patent department, J. I. Case Co., Racine, Wis. W. G. THOMPSON, tractor works manager, will supervise the detailed engineering work at Racine which is assigned to the tractor works and the main works. J. L. FERGUSON, main works superintendent has been transferred from Racine to Burlington as works manager and supervisor of the engineering department there.

*

RAY H. MANSON, who since 1916 has been associated with Stromberg-Carlson Telephone Mfg. Co. as chief engineer, and recently as vice president in charge of engineering, has been appointed vice president and general manager of the company. Formerly manager of engineering, FRED C. YOUNG now becomes chief engineer.

*

H. D. KELSEY has been made manager of General Electric Company's new engineering division at Bloomfield, which co-ordinates all engineering, design and service activities. Mr. Kelsey was formerly head of design engineering. D. W. MCLENEGAN and W. O. LUM have been named consulting engineers, and R. U. BERRY will assist Mr. Kelsey.

*

D. S. BRISBIN has been re-elected president of Motor and Equipment Manufacturers association. Mr. Brisbin is connected with Columbus-McKinnon Chain Corp., Tonawanda, N. Y.

*

CHARLES M. KEARNS JR., in charge of the vibration department of Hamilton Standard Propellers division of United Aircraft Corp., East Hartford, Conn., has been chosen to receive the Lawrence Sperry award for 1939. The award is made for signal contributions to the advancement of aeronautics by the Institute of Aeronautical Sciences for "successful application of methods of measuring propeller vibration stresses in flight."

*

HARRY T. WOOLSON has recently been appointed president of the Chrysler Institute of Technology. He is an executive engineer of Chrysler Corp., and a past president of the Society of Automotive Engineers. Mr. Woolson will continue his duties as executive engineer. JAMES C. ZEDER has been named chairman of the board of education of the Chrysler institute, and CARL BREER and FRED M. ZEDER continue respectively as member of the board and chairman of the board of trustees.

*

M. J. PHILLIPS, formerly of the Glenn L. Martin Co., has joined the Pump Engineering Service Corp., Cleveland, as engineer in charge of hydraulics.

*

RALPH N. HARMON will have under his direction the new engineering department of Westinghouse Electric & Mfg. Co., which will be devoted to the general commercial design and production of radio apparatus of all types. The new department will be known as the special apparatus engineering section. Mr. Harmon, a graduate and later an instructor at Carnegie Institute of Technology, joined the Westinghouse company as a member of its radio engineering department. In 1931 he became general engineer in charge of design, construction and installation of outstanding broadcast equipment.

Noteworthy PATENTS

Magnet Tests Coins

MAGNETIC attraction whether too great or too small as compared with a legal coin determines if a deposited coin will operate a five-cent vending machine. Illustrated in *Fig.* 1 is the design of this coin selector which can discriminate between U. S. coins, Canadian coins and all types of slugs or tokens.

Deposited coins travel down chute shown at upper left and strike a horseshoe magnet. Resilience of coin of diamagnetic material causes it to rebound

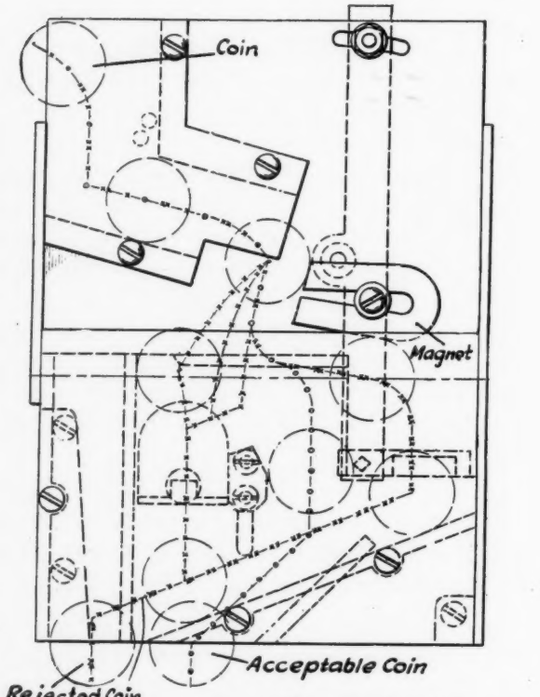


Fig. 1—*Magnetic attraction of magnet determines whether coin is spurious*

from the magnet which acts as an anvil. Path of rebound may vary according to the material but spurious coin enters the rejection chute.

Coins of paramagnetic character, instead of bouncing, cling to the magnet poles and then under gravity roll downward and around the lower edge of the magnet. If a legal coin, it drops almost immediately after reaching lower edge because attraction is relatively weak. Such coins are the acceptable ones and drop into the operating chute at the left of the rejecting outlet.

A third type, those more strongly paramagnetic than legal coins cling to the magnet longer, rolling around its lower edge for a little distance before dropping off. This type drops onto a chute at the right and travels along its inclined plane to be rejected. Separation thus depends upon the relative susceptibility of the coin material to magnetism. Overly paramagnetic coins are rejected and discharged through the same outlet as diamagnetic ones.

This device is covered by patent 2,186,863 and issued to John Gottfried and Benjamin W. Fry, St. Louis.

Birotary Engine Improves Efficiency

STATIONARY valve members with both cylinder and crankshaft assemblies rotating in opposite directions of the type illustrated in *Fig.* 2 provide this birotary engine with advantages over conventional types. Some of these include efficiency of scavenging spent combustion gases, comparatively large and free port areas through which it is possible to introduce and exhaust gases.

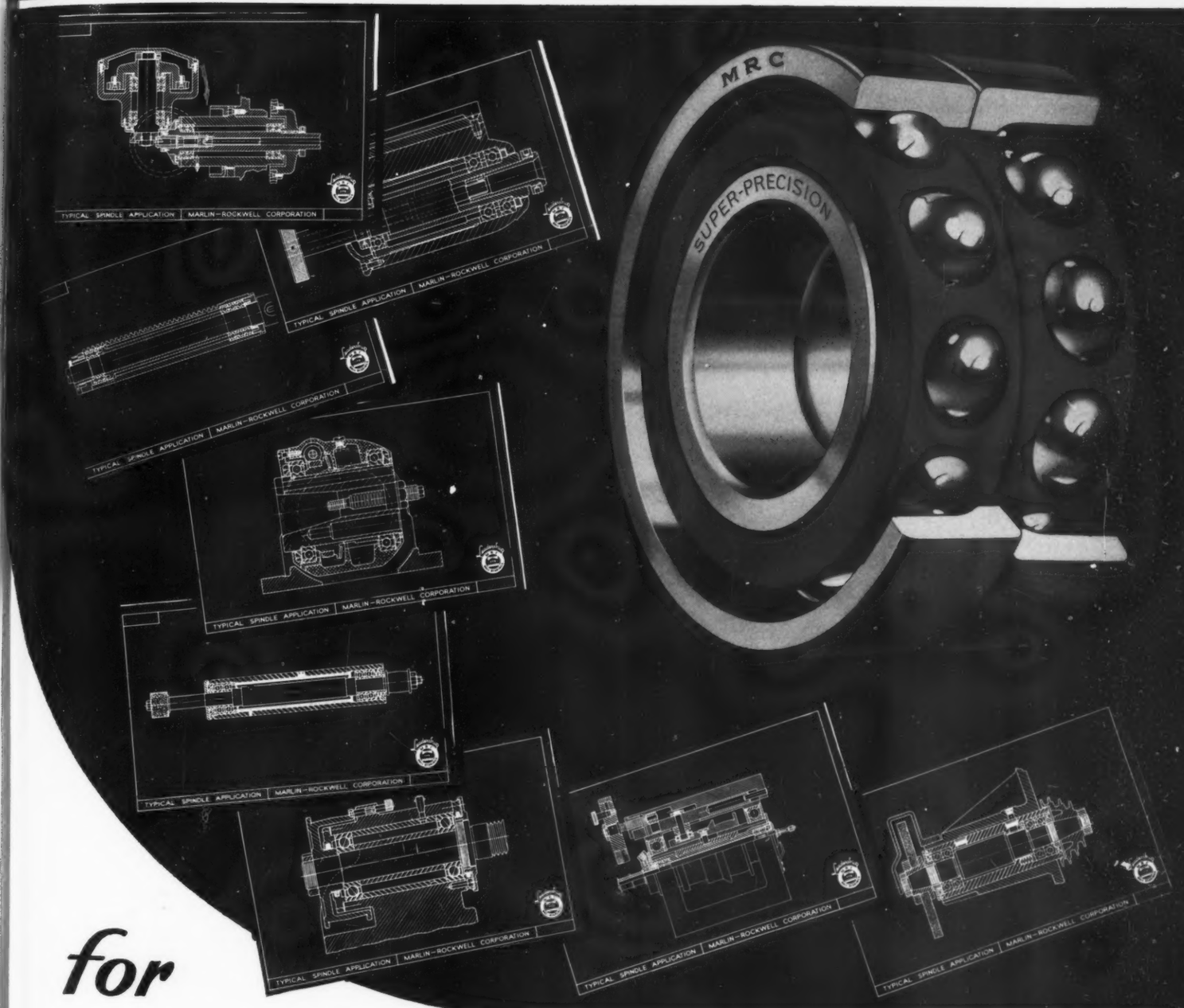
Desired relative rotation of cylinders and crankshaft is obtained from gearing shown in the illustration. A crankshaft gear meshes with a gear fixed on the power take-off shaft. Also fixed on this shaft is a second gear, meshing with an idler which meshes with a gear fixed to the crankcase structure of the cylinder bank.

Stationary housing includes an annular valve member encircling the cylinder ends. Spaced inlet and exhaust ports are placed to conform to the engine cycle. With seven cylinders, the number of exhaust and intake ports is four each. Bearing or sealing faces are spherical with correspondingly fitted sleeves on the end of each piston. Sealing rings similar to piston rings are between sleeves and pistons.

As cylinders approach and pass intake and exhaust

Successful . . .

MACHINE TOOL SPINDLES



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ports, the leading edges are proportioned to provide desirable conditions. For instance the trailing edge of the exhaust port is so shaped that the velocity of exhaust gases does not diminish but rather accelerates at the end of the stroke. In this way, instead

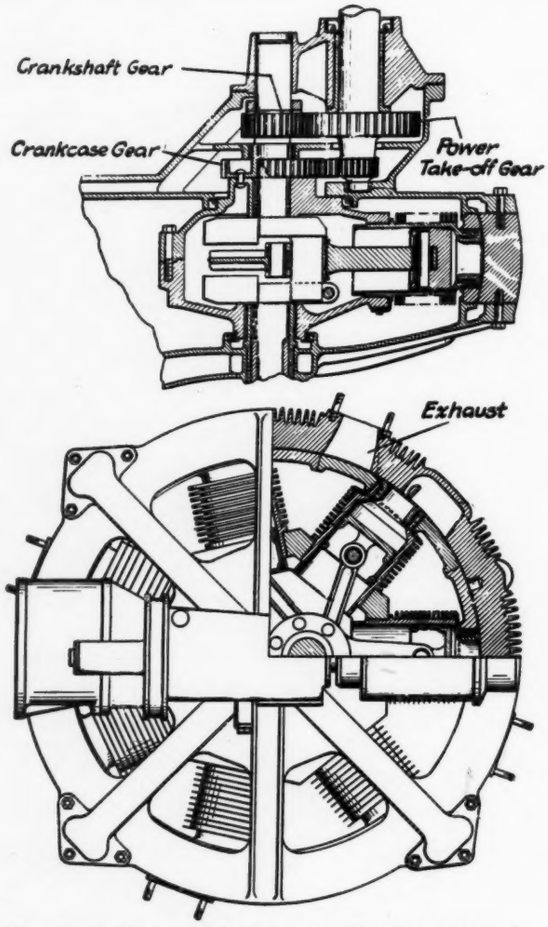


Fig. 2—Both crankshaft and cylinders rotate in new engine. Intake is improved by port design

of the usual turbulence, a partial vacuum is obtained aiding intake at the next port. Similarly, the leading and trailing edges of the intake port are shaped to provide desirable flow of gases.

These features are covered by patent 2,181,705 issued to Andre J. Meyer and assigned to the Mawen Motor Corp.

Simple Clutch Utilizes Electromagnet

CLUTCH operation, electromagnetically controlled, is shown diagrammatically in *Fig.* 3. Simple in design and construction the clutch provides for a limited amount of misalignment through universal action. Also, sticking through residual magnetism is prevented by employing a nonmagnetic sleeve on the driving element and maintaining an air gap even in clutching position.

When the winding is energized, flux in the gap between driving and driven members attracts them together for engagement. Driving shaft is anchored against movement but driven member may be attracted against a spring action toward the driver. Driving head has a nonmagnetic sleeve with a concave conical surface. Driven member has a spherical seat which engages the conical surface of the sleeve in such a manner that misalignment allows movement between the two seats. When engaged a reduced air gap remains both to allow this movement and to prevent residual magnetism from causing the

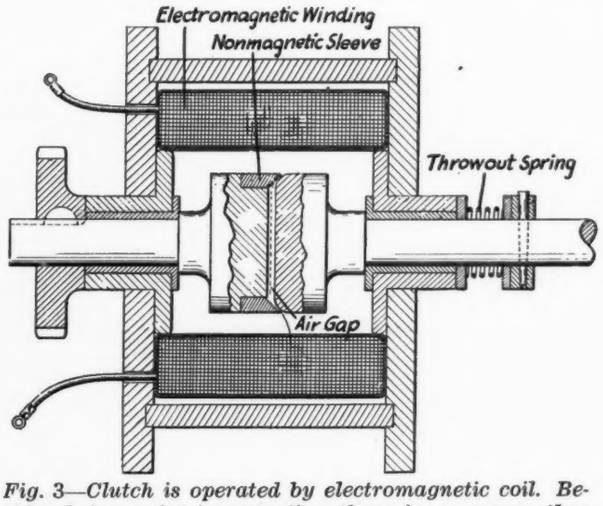
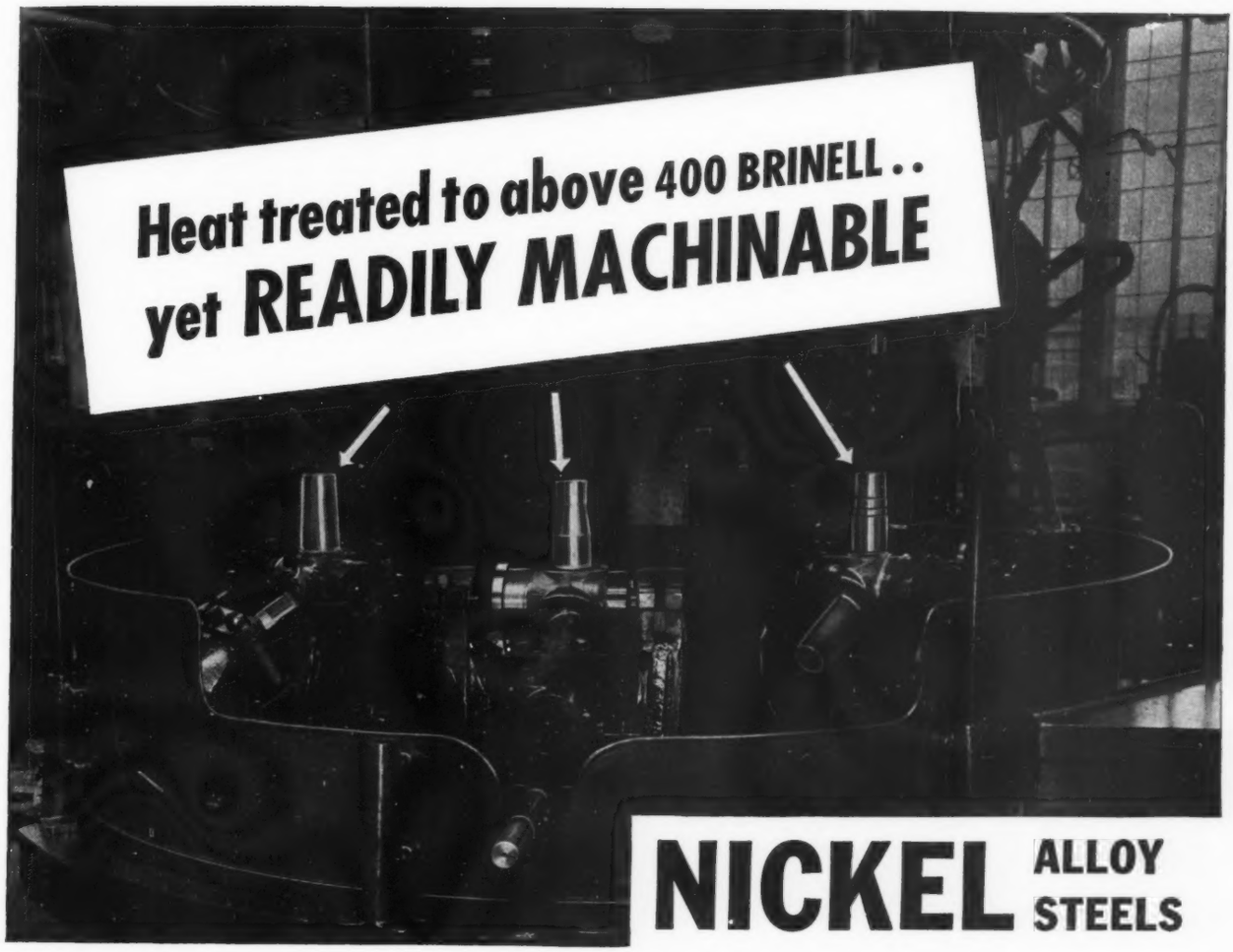


Fig. 3—Clutch is operated by electromagnetic coil. Besides being quiet in operation there is no wear other than that caused by misalignment on clutch faces

members to stick after release, thus preventing the spring from performing its declutching operation.

Because sticking by residual magnetism is prevented by the use of a nonmagnetic ring and a maintained air gap, the clutch spring may be relatively weak.

Small gasoline engines of the model type also have applications other than those in model airplanes and boats. For instance this child's bicycle is effectively powered by a 1/5-horsepower Brown Junior motor. Traction is derived on tire through fibre pulley geared to motor crankshaft. Metal propeller provides air cooling



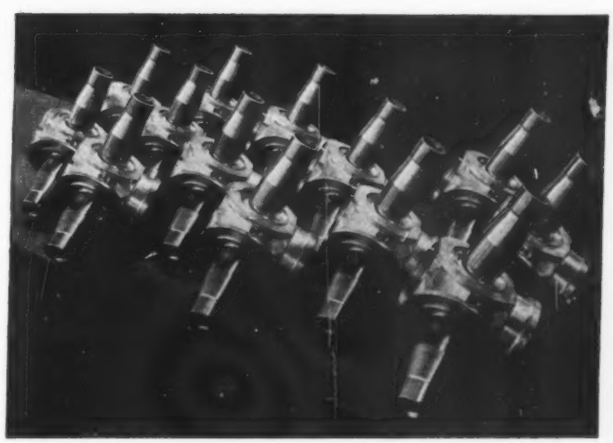
NICKEL ALLOY STEELS

For parts subject to high stresses in service, heat treatment *before* machining offers many advantages. Warpage and distortion frequently resulting from heat treatment after machining are minimized. In addition, points of stress concentration are avoided resulting in considerably greater life for the machined part when placed in service.

Especially interesting are present shop practices of airplane part and other mass production plants now machining heat treated Nickel alloy steels ranging in hardness up to 450 Brinell. *(above)* Stressed Hydromatic Propeller spiders of SAE 4340 heat treated to approximately 415 Brinell are machined with ease in the regular production line at the East Hartford, Conn. plant of Hamilton Standard Propellers, Division of United Aircraft Corp.

• • •

In a recent demonstration on a standard Warner & Swasey turret lathe conventional high speed tools readily turned, chamfered and drilled a 2″ bar of Nickel-chromium-molybdenum steel at a hardness of 450 Brinell. The turning cut was fed at .012″ at a speed of 42′ a minute. The close helical chip showed no tendency to tear, check or burn. The smooth surface produced indicates that machining Nickel alloy steels at high hardness is not unusually difficult.



Hamilton Standard Propellers, Division of United Aircraft Corp., East Hartford, Conn. regularly machine SAE 4340 stressed Hydromatic Propeller parts including spiders, illustrated here, and cams after they have been heat treated to approximately 415 Brinell. Hard Nickel alloy steels are no hazard where machining is concerned. For additional information please write to the address printed below:

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

ASSETS *to a* BOOKCASE

Plastics in Engineering

By J. Delmonte; published by Penton Publishing Co., Cleveland; 6 x 9¼ inches, 475 pages, cloth bound; available through MACHINE DESIGN *for $7.50 postpaid.*

Progress and extent of applications of plastics to design problems are emphasized in this work, second in MACHINE DESIGN's series. The author, J. Delmonte, is a recognized authority on the subject who has gained much of his knowledge through first-hand experimental work and actual application. At present assistant to the chief engineer, Chicago Flexible Shaft Co., Mr. Delmonte also conducts a course on plastics at Armour Institute graduate school, Chicago. Information contained in some of the chapters of his book has appeared wholly or in part in articles written by the author and published in MACHINE DESIGN during the past two years. The leading article of the current issue, on Page 29, is his latest contribution to this magazine.

Since successful applications are achieved only when the designer understands the potentialities, as well as the limitations, of the materials with which he deals, advantages and disadvantages of plastics are discussed at length in terms of various engineering problems. Numerous tests conducted by the author are cited to bear out some of these distinctions and data conveniently tabulated and classified for easy reference aid in understanding. Analysis of some important engineering properties of plastics also is made in terms of the fundamental nature of the materials and correlated phenomena such as condensation and polymerization.

Plastic Chemistry Discussed

In addition to the survey of engineering features, several chapters have been devoted to the chemistry of plastics and to the art of molding them. Review of the raw materials employed in plastics, chemical reactions involved in their formulation, and methods of compounding them serves as an introduction. This information is organized as conveniently as possible for ready reference. The chemical background is essential to the correct scientific analysis of problems arising in the molding of materials and their behavior in service.

Inasmuch as the large majority of plastics utilized in machine design problems is applied as molded articles, a comprehensive analysis is given of molding problems and mold designs. The laminating, casting and extruding of organic plastics are discussed similarly.

While designers may not ordinarily consider surface coatings and synthetic rubbers in terms of plastic materials there are many close relationships. A chapter devoted to each of these subjects bears out these connections and discusses the engineering properties.

This work takes rank as the first prepared directly for the designer on the subject of plastics and their potentialities and applications. As the plastics industry continues to expand through development of new materials and refinements in the art of forming them, *Plastics in Engineering* will be found increasingly valuable for an understanding of the field.

□ □ □

Industrial Design, a Practical Guide

By Harold Van Doren; published by Mc-Graw-Hill Book Co., New York; 365 pages, 6 x 9 inches, cloth bound; available through MACHINE DESIGN *for $4.50 postpaid.*

The job of an industrial designer, as the author explains it, is "to interpret the function of useful things in terms of appeal to the eye . . . to create in the consumer the desire to possess." With this premise in mind, Mr. Van Doren proceeds to discuss various aspects of the ten-year-old profession of industrial design, or "styling." Continual emphasis is laid on the need for casting aside starry-eyed visions of the profession and of viewing the work as a task requiring "persistence, industry and an unusual variety of technical skills."

Readers of MACHINE DESIGN will discover considerable material in the book which appeared in this magazine within the past five years. Reports of the interest aroused by these articles, according to the author, eventually led to fuller treatment of the subject in book form.

Four parts comprise the volume. The first surveys the field, points out the scope and difficulties of the profession, outlines proper preparation for industrial designing, and discusses fees. An elementary treatise

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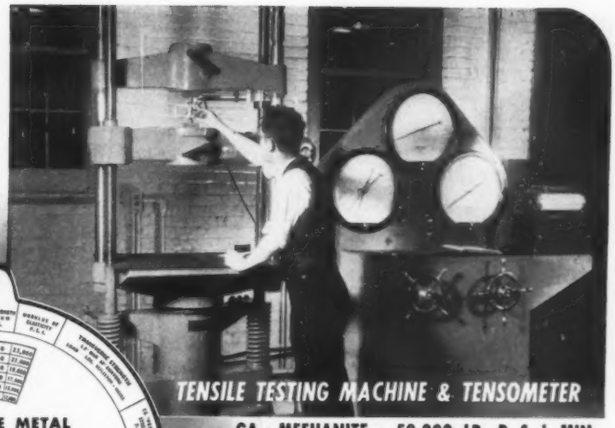

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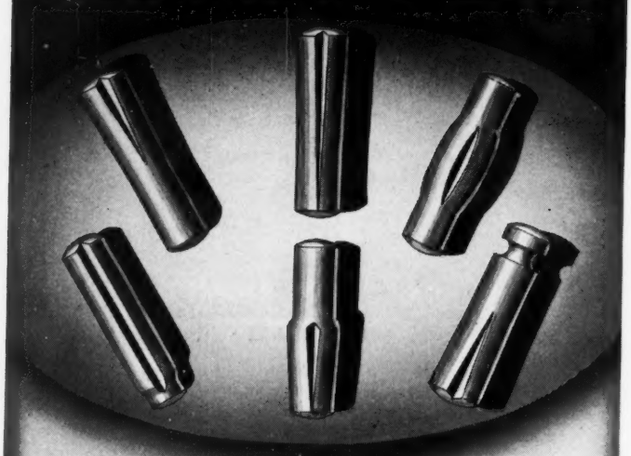

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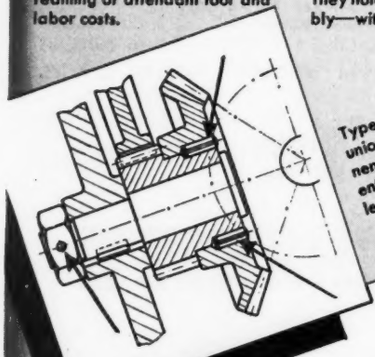
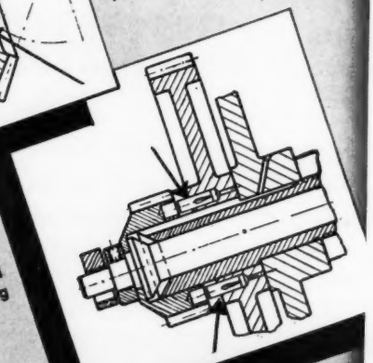


Type 3 Groov Pins serving as union for gear wheels. Permanent, equal holding power over entire length of pin. Unequalled, efficient fastening.



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on designing in three dimensions makes up the second part. Nothing is taken for granted in the way of knowledge on the reader's part. By first referring to the most primitive and elementary concepts of design, the author proceeds by allusion and example to build a foundation for a more sophisticated understanding of design.

The third part, on technique, tells how to set about making a practical design, including organization of preliminary data, rough sketches, and presenting ideas to superiors or clients. Practice is treated in the final part, a few problems being offered for the beginners, with a number of possible solutions to each. The concluding chapter gives actual case histories describing the development of products already on the market. A series of photographic plates is appended at the end of the book, showing step by step production of actual machines.

The excellence of Mr. Van Doren's book is increased by the fact his undoubted design ability is supplemented by a facility for word-painting. Sparkling writing is evident throughout, with the result that a subject which might seem "fancy" is made remarkably clear and absorbing.

□ □ □

Design This Day

By Walter Dorwin Teague, published by Harcourt, Brace & Co., New York; 261 pages with appendices, 7 x 9¼ inches, cloth bound; available through MACHINE DESIGN *for* $6.00 *postpaid.*

Industrial design, as exhibited in machines in everyday use, is not the only subject discussed in this book. Indeed, it is just one phase of the larger premise of Mr. Teague; namely, that a fundamental redesign of the world is needed and that machines fit into that picture side by side with other products of engineering skill such as buildings and roads. The purpose of the author has been "to outline with reasonable clarity the technique that must be applied to the solution of any problem of design, whether it is a new motor car or a new city or a new environment. . . . It is a listing of the factors that must be dealt with if satisfactory order is to be created on a small or a large scale."

While discussing the principles which he feels should be back of such a redesign, however, the author does treat many subjects applicable to industrial design, or styling. These include adaptation of form to function; adaptation of form to materials and techniques; unity and simplicity; rhythm of proportion, line and form; accent, scale and emphatic balance. Excellent photographs and schematic drawings help to clarify these points. For far-seeing designers seeking to adapt their machines to an orderly future world, this book provides ample food for thought and example.

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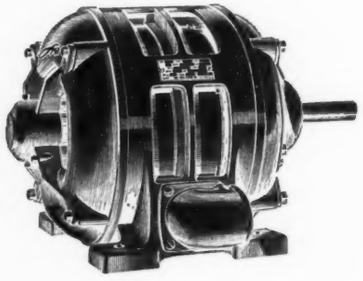
Motor Designed for Refrigeration

ESPECIALLY designed for use on refrigerating and air-conditioning and similar applications, a new "Lo-Amp" motor is announced by The Louis Allis Co., Milwaukee. This motor has low locked rotor current

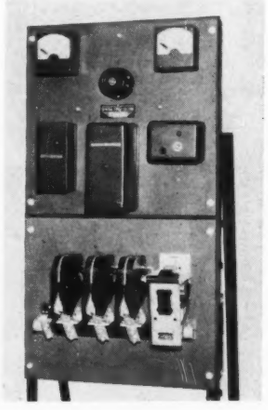


New "Lo-Amp" motor has low locked rotor current and can be supplied with high or normal starting torque

and can be supplied with either high starting torque or normal starting torque. It has no centrifugal switches, relays, brushes or slip rings and does not require any special control to operate.

Controls Synchronizing Speed

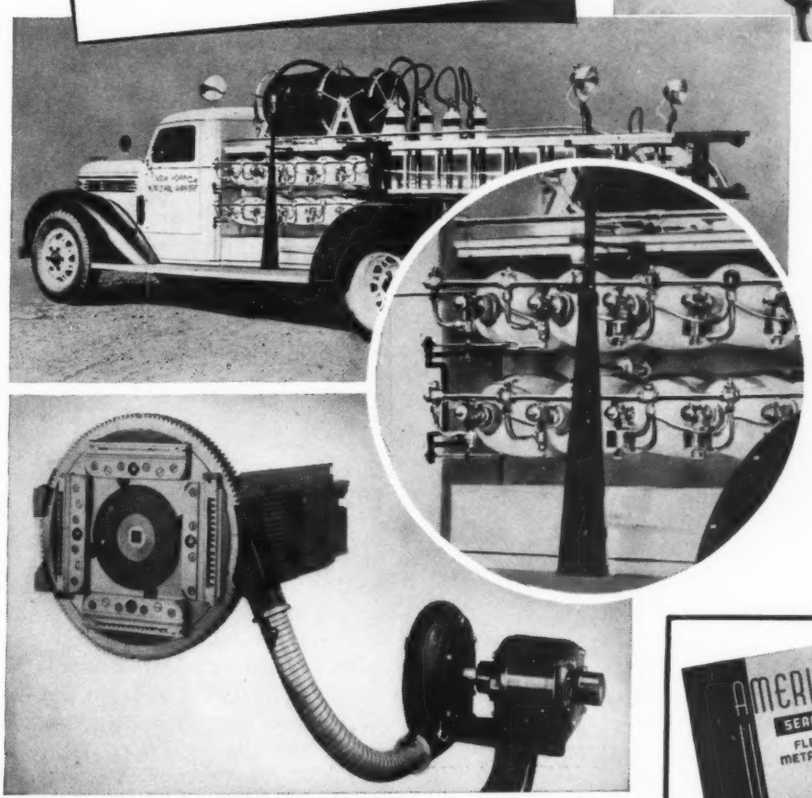
A NEW synchronous motor control developed by General Electric Co., Schenectady, permits accurate control of synchronizing speed, so that the field cannot be applied until the motor has reached a speed at which it can synchronize its load. This speed is



Control applies field to synchronous motor only after motor reaches synchronous speed

easily set on a trial start by an adjusting screw on the front of the control, which features the General Electric slipcycle impedance SCI relay. Undesirable current and torque fluctuations are avoided, because the field can never be applied unless the load can be synchronized. The control waits until the motor reaches the correct speed, then selects an instant of favorable angular

See how problems disappear when *Flexible Metal* hose is used!

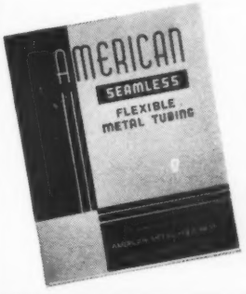


Electrical disturbances in aircraft radio were a problem until instrument makers found this economical, dependable means of solving it. It is flexible *aluminum shielding conduit* for low tension wiring. Its use not only ended frequency noises, but because the shielding is extremely flexible, it could be bent around tight places and pushed back into corners. This solution to a typical design problem became a U. S. Govt. specification.

•

When Walter Kidde Co., of Bloomfield, N. J., designed this special crash truck for New York's North Beach Airport, there was one important kink—what to use to connect the series of CO_2 tanks you see here? It must be seamless for safety's sake...must be flexible since the tanks were frequently removed for weighing... and must be as durable as the truck itself. The answer, in this, as in thousands of similar cases, was *American Seamless Flexible Metal Tubing.*

The *flexible metal hose* on this blower used in Mergenthaler Linotype machines to bathe linotype molds with cool, clean air in order to keep the temperature just right performs three simple but important functions. Flexible hose can be directed so that air hits exactly where it is needed... it's easier to install... is neat and conserves valuable space.



These and hundreds of other design problems involving flexible metal connectors in the conveyance of steam, air, oil and other liquids and gases have been solved by the products of American Metal Hose. The book illustrated will bring you complete and detailed information on American Seamless, the most dependable flexible metal tubing you can specify. 40245

American Metal Hose

ANACONDA
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Write for sample testing sheets of Micro-Weave tracing cloth — try it yourself.

THE HOLLISTON MILLS, Inc., Norwood, Mass.
Companion Products: Royal Blue Print Cloth and Photo Cloth.
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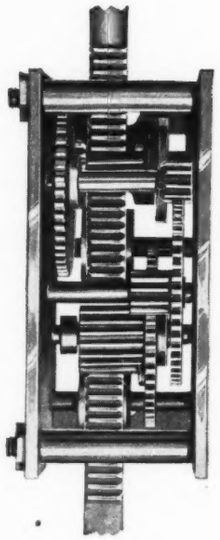
relation of stator and rotor poles to apply field. Pulsations in case of motor pullout are prevented by the SCI relay by promptly disconnecting the power (or field if automatic resynchronization is desired). This system of field application is available for control of all ratings of synchronous motors. Magnetic or semi-magnetic forms are available for full voltage, reduced voltage or part-winding starting.

Announce Gear-Escapement Unit

A GEAR and escapement mechanism consisting of a train of heavy gears, pinions and a gear rack, is announced by Walser Automatic Timer Co., 420 Lexington avenue, New York. When operated by weight or spring, the rack drives the gear train through a ratchet-held loose pinion which, on reverse motion, is released to permit the rack to be manually or electrically returned to its starting position. The unit may be adapted for mechanical tripping or electric control



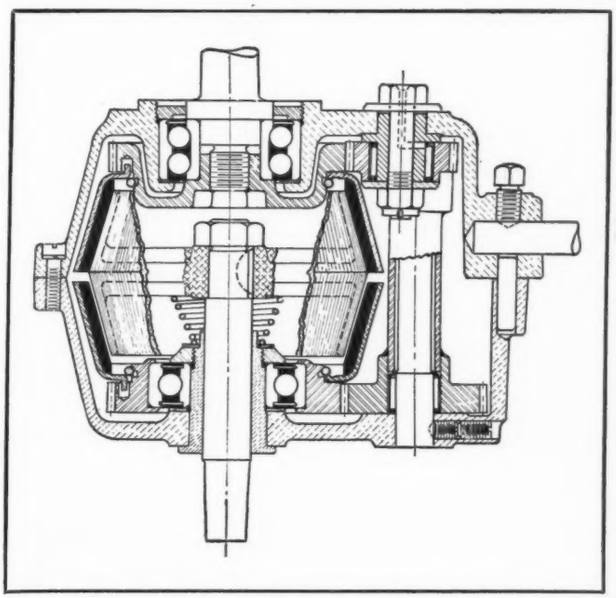
Gear and escapement mechanism may be adapted for mechanical tripping or electric control operation

operation in fixed or adjustable intervals and single or repeat operating cycles. Constructed of heavy brass and steel, the mechanism has gears and pinions cut from solid stock. Points of wear are hardened for long and dependable operation under heavy duty conditions. A variety of timing ranges from a few seconds up to approximately three minutes is possible, depending upon the gearing, length of rack and operating weight utilized.

Raise Ratings of Motor Line

HIGHER horsepower explosion proof motors are announced by U. S. Electrical Motors Inc., 80 Thirty-fourth street, Brooklyn, N. Y. In Class I, Group D motors, the ratings have been increased from 25 to 75-horsepower; in Class II, Group G ratings have been increased from 7½ to 75-horsepower. The larger motors are of the shell type frame construction and have a specially designed fan which is quiet even at high speeds. Wiring is made more convenient with a larger terminal box. The fan-end inner end bell and the outer

"TORRINGTON NEEDLE BEARINGS *Run for Weeks with only Occasional Oiling"*



(*Above*) View shows the Torrington Needle Bearings on idler gear and quill gear shaft in the Ettco Tapper, and single row Torrington Ball Bearing on clutch gears.

(*Right*) In the Ettco 1-B Tapper, reversing clutches impose heavy intermittent loads on the Torrington Needle Bearings. Torrington Ball Bearings are also used in this unit.

BETTER LUBRICATION with little service attention is the outstanding advantage that Ettco Tool Co., Inc., gives its customers by using Torrington Needle Bearings on idler gear and quill gear shaft in its 1-B Tapper.

In this application the Needle Bearings are subjected to heavy additional intermittent loads as the reversing clutches operate. "Bronze bushings formerly used were difficult to keep properly lubricated," say Ettco engineers. "Now we have no trouble, as the equipment can run for weeks with only occasional oiling.

"In the four years since we adopted the Needle Bearing, we have had a remarkable performance record. We are getting excellent results, and intend to use more of these bearings in other equipment of our manufacture."

You too can incorporate these advantages in your product—and you can do it at surprisingly little cost. The Torrington Needle Bearing is inexpensive to buy—easy to install. Existing designs can readily be adapted to use the Needle Bearing. It can be mounted in the simplest type of housing—takes up no more space than a plain bushing—yet has exceptionally high radial load capacity.

The Torrington Engineering Department will gladly work with you in laying out applications for the Needle Bearing in your products. For further information, write for Catalog No. 9. For Needle Bearings to be used in heavier service, request Booklet No. 103X from our associate, Bantam Bearings Corporation, South Bend, Indiana.

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Makers of Needle and Ball Bearings
New York Boston Philadelphia Detroit
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TORRINGTON
NEEDLE BEARING

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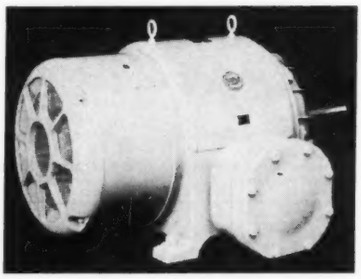
fan cover bracket are held in place with a simplified type combination screw. This construction eliminates one set of holding screws and supplies rigid and secure

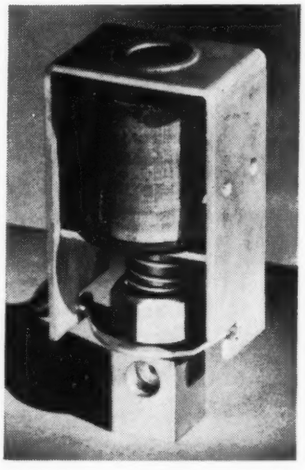


Ratings up to 75-horsepower are now included in line of explosion proof motors with shell type construction

mounting for the fan cover and bracket, as well as facilitating assembly or disassembly of the motor.

Solenoid Adapted to Heating Use

PARTICULARLY adapted to the requirements of the heating and air conditioning industry and to general applications in the control of air, oil, water and gas, a new solenoid valve has been introduced by General Electric Co., Schenectady. It may be used as water control for humidifiers, water control for laundry and dishwasher equipment, oil shutoff for oil



General applications in the control of air, oil, water and gas find use for solenoid valve

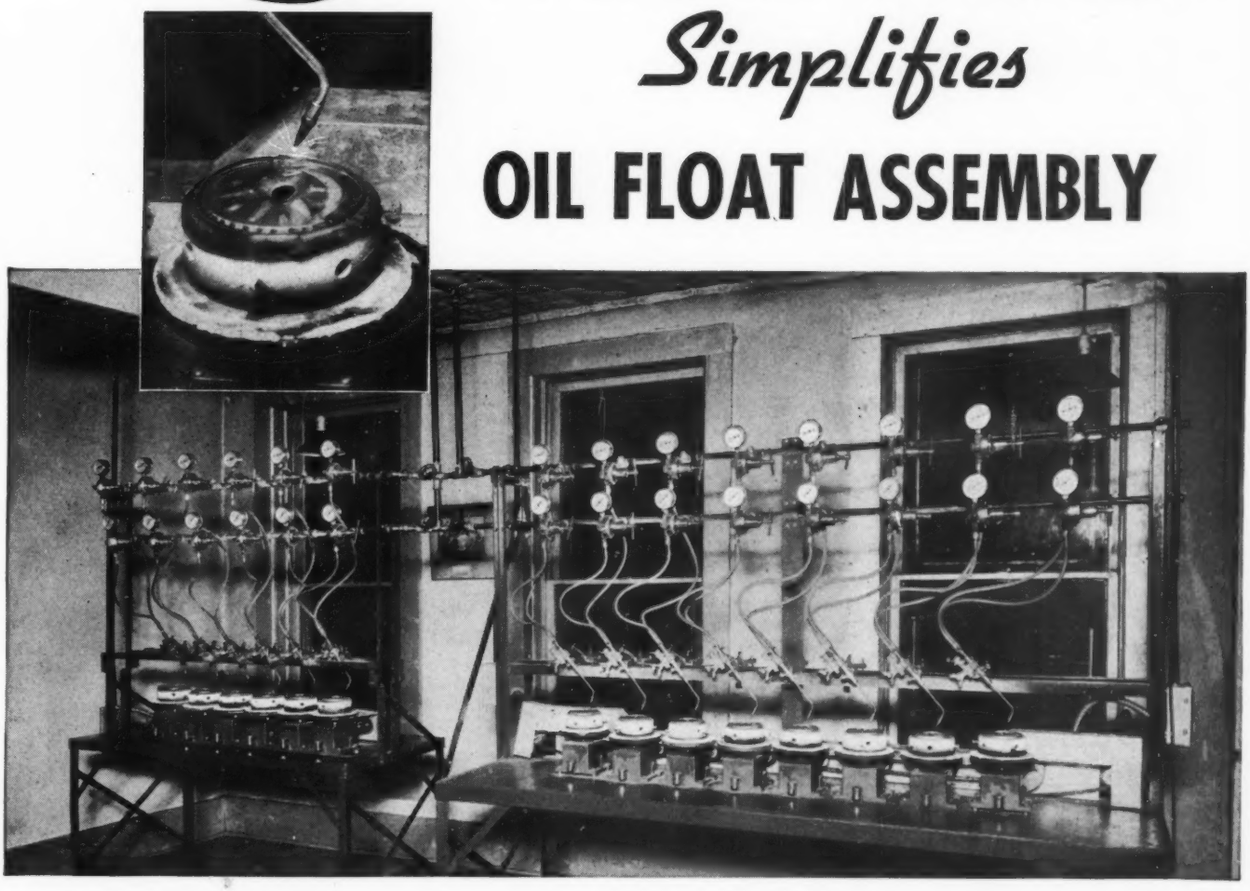
burner service, pilot-gas control for gas burners, air control for compressed air devices, or for evaporative cooling equipment. Since it is designed to be incorporated into an assembly that has its own enclosure, no coil cover or conduit plate has been provided, as the illustration shows.

Bronze Tubing Unusually Flexible

SEAMLESS bronze tubing of 4-inch inner diameter which can be bent to a radius of 6 inches, is announced by Seamlex Co. Inc., 5 Forty-eighth avenue, Long Island City, N. Y. Pronounced S-shaped corrugations ¾-inch deep and relatively close pitch are responsible for the unusual flexibility. The convolutions

AIRCO

WELDED DESIGN *Simplifies* OIL FLOAT ASSEMBLY



Skimming the "cream" from the crankcase oil to assure clean, viscous oil is the job being done by the Taylor Float-O-Oil suction intake. Speed plus permanent tightness are two "musts" in the assembly of this oil float.

Oxyacetylene welding proved to be the best method of attaining these essentials. Using the economical Airco production welding process, the thin pressed steel body and cover of the oil float are welded together with a "standing seam." Then, a brass pipe gooseneck is joined to the steel body at the side and to the cover plate. The result — a light, permanently tight, speedily assembled float which rides on the oil's surface, rising and falling as the oil level changes.

This is another example of how Airco customers are continually benefiting by using economical Airco Oxygen, guaranteed to be 99.5% pure (it exceeds U.S.P. requirements), Airco Acetylene, Airco Welding Apparatus and the assistance of Airco's Applied Engineering Department. Airco engineers will be glad to send our experienced adviser to help you solve any problem involving the use of the oxyacetylene process. Write for full details.

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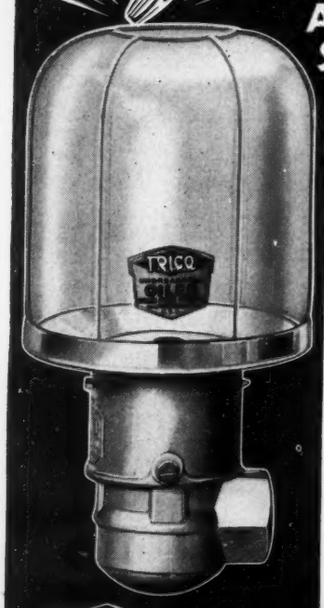
Unbreakable OILERS
MODERN! VISIBLE! AUTOMATIC! STREAMLINED!



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- Improve the appearance and efficiency of any machine.
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- Reduce sales resistance and insure accurate, dependable lubrication after the equipment is in service.

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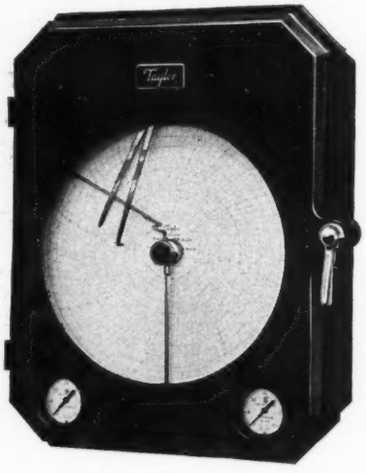
TRICO

TRICO FUSE MFG. CO. Milwaukee, Wis

form a lefthand helical thread, assuring uniform distribution of stress and therefore long hose life. Covered with a bronze braid jacket, the tubing will withstand a safe internal working pressure of 150 pounds per square inch. Since it is of all-metal, seamless, jointless, and packless construction, the hose is suitable for conveying steam, water, oil, gas, air, etc. Radiation area is approximately 495 square inches per foot. Weight per foot is 6.5 pounds.

Controllers Redesigned

A COMPLETELY redesigned line of Fulscope air-operated recording and indicating controllers for temperature, pressure, rate of flow and liquid level is announced by the Taylor Instrument Companies, Rochester, N. Y. In addition to the conventional proportional response and automatic reset forms of control, the new Fulscope has a third process-control effect, called Pre-Act. Pre-Act is a supplementary control



A third process-control effect has been added to line of controllers, making control valve corrections according to rate of control-point deviation

feature which makes control valve corrections according to the rate of control-point deviation. In response to sudden disturbances in the process or variations in the controlling medium, over-peaking or oscillating is greatly reduced by an immediate and relatively larger control valve action than would occur otherwise. The automatic reset feature, which compensates for changes in load, is located in the instrument case and is fully adjustable over a much wider range than previously. Maximum ease in making adjustments is provided by magnified dials on the instruments, calibrated in absolute units.

Two Thermostats Developed

FOR roasters, water heaters, and similar built-in applications a new sentinel thermostat has been announced by Westinghouse Electric & Mfg. Co., Mansfield, O. A guardsman thermostat designed specially for ironing machines is also announced. The bimetal of the sentinel thermostat does not carry the current but is designed to act as a switch when turned to a low position, thus assuring accurate performance of the heating unit. These thermostats have an adjustable range from 32 to 450 degrees Fahr. and a maximum rating of 15 amperes at 115 volts and 10

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Do you know the CORRECT answers?

* What TYPE bearing should you use?
* What ALLOY will deliver the best performance?
* What TOLERANCE should you specify?
* Where should the OIL HOLE be placed?
* Should you use OIL GROOVES —what style?
* Should REPLACEMENT be considered?
* What are your present COSTS?

Ask JOHNSON BRONZE

● There is a **RIGHT** answer to every question. There is the **RIGHT** bearing for every application. With so many types of bearings . . . so many alloys available . . . the product designer and engineer is likely to become confused. Yet this confusion is unnecessary. Simply present your problem to Johnson Bronze. We will give you the **CORRECT** answer.

Johnson Bronze is particularly well fitted to give you this service. As manufacturers of **ALL** types, we base our recommendations entirely on facts . . . free from prejudice. Our judgment is seasoned through more than thirty years' exclusive bearing experience. Our organization and our complete facilities are geared to one idea . . . that of giving you bearings that will deliver the greatest performance . . . that are most economical to use.

Why not make use of this service? It costs you nothing . . . may save you much.

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FEL-PRO METALLIC PACKING

FEL-PRO flexible metallic packing is furnished in standard and special styles for many applications in industrial and marine fields. Individual strands are formed by the longitudinal folding of foils. Metallic strands furnished either cored or uncored. Basic metals used are lead, aluminum or copper.

FEL-PRO *extra service* is not confined to the product itself! FEL-PRO engineers are at your service to help you select the best obtainable material to fully satisfy the highest requirements of *your particular* machines. No matter how limited your needs, FEL-PRO engineers will be glad to work with you to provide the proper packing that will furnish *extra service life* and durability.

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METALLIC PACKING

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SPRINGS and screw machine parts are only as good as they function and fit the general design of the product. This calls for experience, and experience comes from practice, which takes time.

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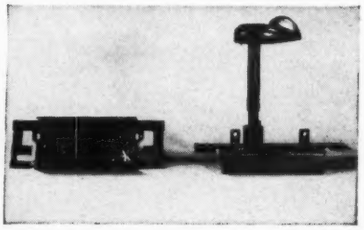
PECK SPRINGS
AND SCREW MACHINE PARTS

The Peck Spring Co. **10 Wells St., Plainville, Conn.**

amperes at 230 volts, alternating current. Rating of the guardsman, with its slow make and break, depends upon the type of service in which it is used. It

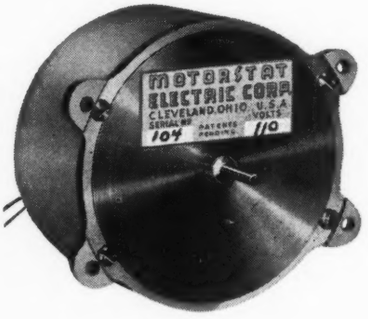


Bimetal of thermostat does not carry current but acts as switch when turned to low

is adjustable over a range of approximately 250 degrees Fahr. with a maximum alternating current rating of about 7.5 amperes at 115 volts.

Motor Synchronizes At Once

TO MEET the need for a quick-starting, powerful, vibrationless source of power for driving light machinery, a new self-starting synchronous motor has been announced by Motorstat Electric Corp., 5005 Euclid avenue, Cleveland. Possible applications include fans, movie projectors, advertising displays, switches, timing devices, air purifiers, heaters and traffic signals. Output speeds are obtainable at any figure from 60 revolutions per minute to one revolution every 60 minutes. Standard torque ratings from 10 to 100 inch-ounces are available on specification. Absolute acces-



Vibration eliminated by accurate hob cut gears and dynamic and static balancing in self-starting synchronous motor

sibility to all parts at any time is provided by the design of the cast and machined aluminum housing, which can be pulled off after loosening only six screws. The housing remains the same, regardless of output speed or torque rating. An exclusively designed solid rotor gives tremendous power and unusually high starting torque. No "warm-up" period is needed, the motor reaching a synchronous stage almost immediately. Accurate hob cut gears plus dynamic and static balancing eliminate objectionable vibration. Oilite self-lubricating bearings of powder bronze are used throughout.

Develop Universal Connector

CALLED the universal speed connector because of its ability to take from No. 14 to No. 4 wire, and because it saves time in wiring, a new solderless connector has been developed by Square D Co., Detroit. The connector is free to rotate around the screw, thus allowing wire to be inserted from almost any angle. This feature is important, of course, where large wires

EASY TO FEED . . . ACCESSIBLE . . . SIMPLE TO OPERATE PEASE STREAMLINED MODEL "12"

PEASE MODEL "12" GIVES YOU A BONUS OF TIME SAVED, FOR 3 REASONS:

1. **Model "12"** is easy to feed. . . . Tracings enter at the front without tugging and steering, always under control, readily released if necessary.

2. **Every part** of Model "12" is perfectly accessible . . . Lamps, Water Tanks, Drying Drums and Drainage. Clean up time is no longer a back breaking chore.

3. **Model "12"** is simple to use. . . . The operator now spends most of his time feeding and trimming. There are fewer controls and those few are located within easy reach.

All of this simplicity is in addition to the 5 outstanding mechanical features:

Sliding Contact . . . which smooths away wrinkles.

Patented Lamp Circuit—Lamps burn 45 minutes without a break.

Horizontal Water Wash—No tension wrinkles.

Quick-Change Chemical Applicator—30 seconds from Blue Prints to Negatives, or vice versa.

5 **Drying Drums**—Prints flat as hung wall paper at **12 ft. per minute.** Don't let time loss eat your profits. **Your Blue Printing savings are easy to realize with Model "12."**

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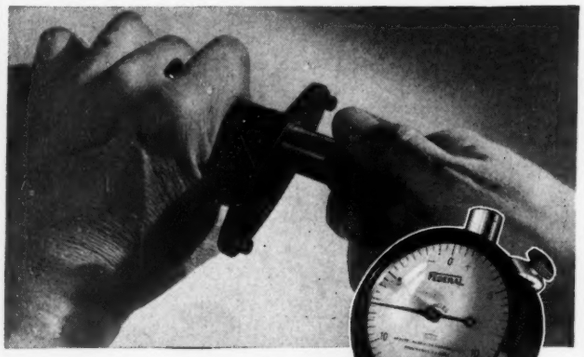

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The sense of *feeling* or of *touch* as applied to fixed gages when used to determine the accuracy of specified sizes on machine parts, depends upon the sensitivity of the inspector and varies with each individual. But, a visible indicating hand, moving over widely spaced dial graduations, is something which can be seen with the same degree of accuracy by *anybody*.

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TUTHILL PUMPS

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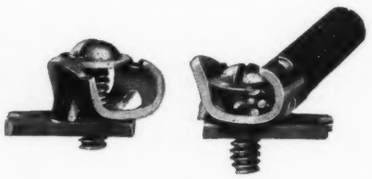
are used in a limited space. The connector is self-centering so that wire need not be wound around the stud. As the screw is tightened, the lug is forced to one side and the wire is gripped tightly. When the

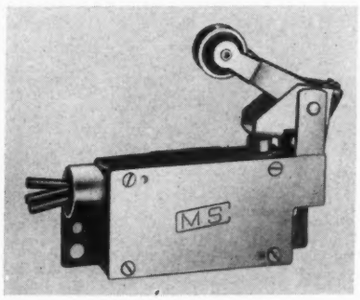


Solderless connector is designated as universal because it takes various sizes of wire

tightening is completed, the screw exerts pressure against the wire on one side and the lug on the other. Thus bending of the screw is prevented while positive contact is assured.

Cams Actuate Limit Switch

A NEW precision limit switch for actuation by rotating or sliding cams, known as LK-2, is announced by the Micro Switch Corp., Freeport, Ill. It has a roller actuator that is adjustable through an arc of 225 degrees. The switching element contained in the steel housing is a single pole Micro switch with normally open, normally closed or double throw contact arrangements. The LK-2 has a movement differ-



Precision limit switch has a roller actuator that is adjustable through an arc of 225 degrees

ential at the roller of .002-inch, a pretravel of one degree, an overtravel of 20 degrees and an operating pressure of less than 1.8 pounds. Interchangeability is possible because the operating point is held within plus or minus .002-inch with relation to mounting dowels. It is resistant to oil and water and has a life of over a million operations.

Plugging Switch Uses Alnico

USE of an Alnico magnet as the fundamental part eliminates frictional parts of clutches and contributes to low maintenance costs and long life in a new plugging switch for controlling motor stopping, introduced by General Electric Co., Schenectady. In the new switch, a driven Alnico rotor produces a rotating magnetic field which induces eddy currents in the walls of the aluminum cup. The magnetic reaction produced by the eddy currents turns the cup through its limited rotation and the contacts are operated by the Textolite rod which connects the cup and the movable contact strip. Centering springs tend to keep the contacts in the normal position but since the magnetic operating force on the aluminum cup is dependent on

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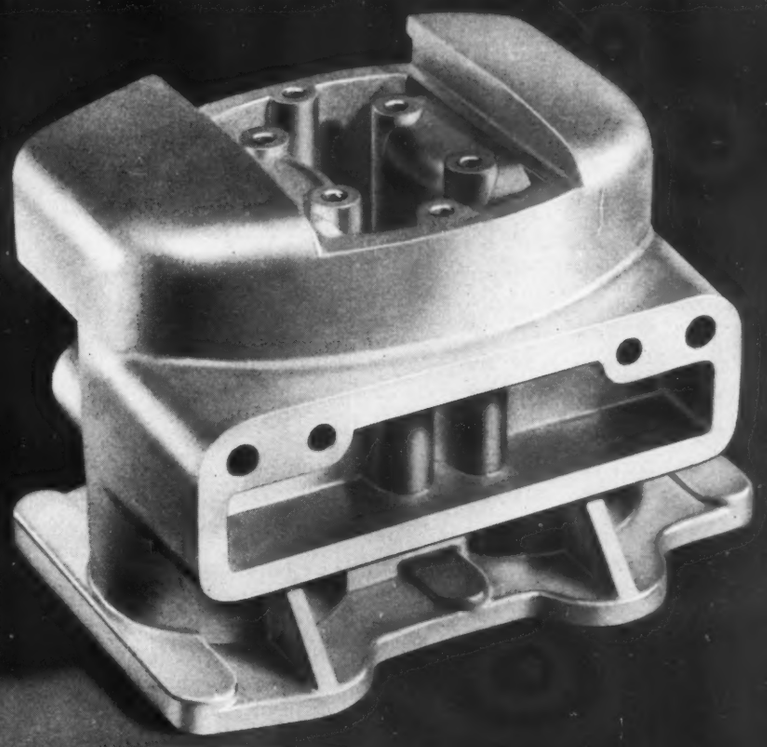


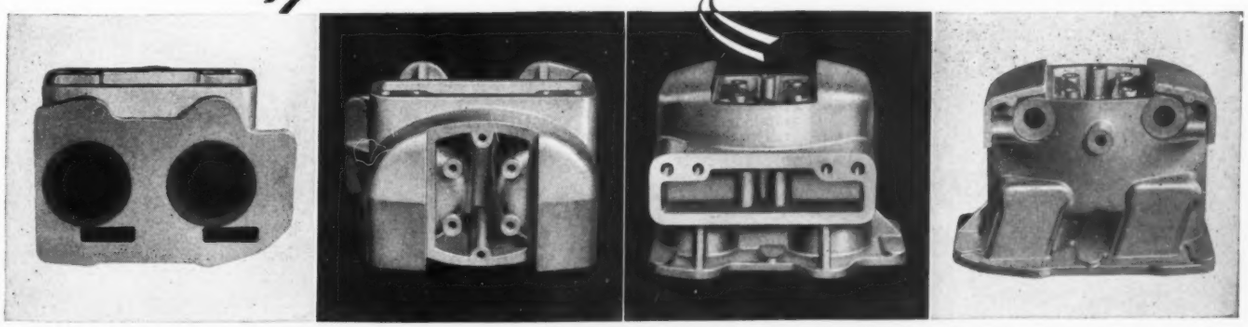
hi-high
PRESSURE CASTINGS

Expert Designing by Evinrude Motors, Milwaukee, Making Full Utilization of the Madison-Kipp hi-high Pressure Aluminum Die Casting Process.

STRONGER—MORE DENSE
Aluminum Die Castings

The new fast Madison-Kipp patented hi-high pressure casting process has brought about a complete change in Aluminum Die Casting work. Only a short time ago many manufacturers considered Aluminum die castings too costly and non-uniform for the more complicated parts and for the mass production parts. One penalty after another has been erased until now there are companies who use upwards of a million pounds of Aluminum die castings a year, who swear by the clear-cut superiority of the hi-high pressure castings and Madison-Kipp dies. Madison-Kipp maintains a complete die casting department for all die casting alloys of Aluminum, Zinc, and Brass.

PROOF *Photographs show all sides of this 1940 Evinrude Cylinder with cast-in iron cylinder walls. The Madison-Kipp die for it is self-contained and fully automatic in operation.*



Sole Agent in England: Wm. Coulthard & Co., Ltd., Carlisle

MADISON-KIPP CORPORATION, 210 Waubesa St., Madison, Wis., U. S. A.

DESIGN ON PARADE

Dramatic changes are taking place daily in thousands of engineering departments. Designers working diligently over drawing boards are carrying out important decisions that will affect thousands of people.

Many machines in use today will be obsolete tomorrow. This constant change proceeds swiftly and silently, bringing to everyone the benefits that only greater utilization of more and better machinery can produce.

With each decision in engineering departments, the fate of numerous commercial parts and materials stands or falls. Only through determined effort to influence and sell the design executives can the producers of these parts, materials and accessories hope to gain and hold acceptance of their products.

As these changes in design take place MACHINE DESIGN is at the elbows of the men who make them. These engineers depend on their "Professional Journal of Chief Engineers and Designers" to steer a clear course, and are confident that they have at hand the latest authoritative data from which to draw conclusions and make selections.

speed, contacts operate at and above a definite speed. As the speed decreases, a point is reached where the spring force overcomes the magnetic force, and this

Frictional parts or clutches are eliminated in plugging switch by use of Alnico magnet as principal part

is the tripping point. Changing spring tension provides a way to adjust tripping speed over a definite range.

Switch Actuated from Thermostat

A MAGNETIC switch announced by General Electric Co., Schenectady, controls air-conditioning equipment motors directly from the contacts of a room thermostat or other low-voltage control instrument. This unit consists of a three-pole magnetic switch mechanism, overload relays and a low-voltage control transformer, assembled into one compact unit. It protects a motor against overload by its manual or automatic reset overload relays and with its low-voltage control terminals on the outside of the enclosure, assures complete isolation of the pilot circuit from the power wiring. A normally open interlock is furnished to provide correct sequencing with other equipment when desired. The operating coil is isolated electrically from the power circuit, providing the maximum flexibility for wiring.

Series of Reset Timers Announced

AN ALMOST unlimited number of difficult operations can be precisely controlled by the new series of automatic reset timers and time delay relays announced by Paragon Electric Co., 37 West Van Buren

Automatic reset timers and time delay relays control almost unlimited number of difficult operations

street, Chicago. These timers are furnished with eight terminals. A positive mechanical lock, magnetically

"CARTRIDGE" BALL . . . BEARINGS

SIMPLIFY your design by eliminating supplementary outside closure parts and protective seals.

PROTECT against the dirt hazard by the use of highly effective, wearless metal seals that positively exclude foreign matter and retain grease at any angle.

SAVE by cutting out many costly machining operations and extra parts, and by speeding up production.

INSURE longer life and lower maintenance costs by providing 100% greater grease capacity; refilling plug and removable seals facilitate regreasing and inspection.

Made to Standard Double-Row Widths, with 100% Greater Grease Capacity.

The manufacturers whose names appear above are among the many using "CARTRIDGE" ball bearings to advantage in their equipment.

Write for the Catalog. Let our engineers work with you.

NORMA-HOFFMANN BEARINGS CORP'N., STAMFORD, CONN. U.S.A.

Felters' Responsibility Carries Through!

NOT only are we responsible for the high quality of Certified Felt, but we also feel responsible for the performance of Certified Felt in the product into which it goes. Whether it be an oil filter, a bearing, an airplane cabin, a radio, or any other product in which Certified Felt is used, perfect performance can be depended upon, for we see to it that our product does the job it is supposed to do.

THEREFOR, if you need felt, you want Certified Felt; if you get Certified Felt, you get all Felters' services.

THE FELTERS COMPANY, INC.
210 SOUTH ST., Dept. K-4 • • BOSTON, MASS.
OFFICES IN PRINCIPAL CITIES

operated, eliminates clutches and frees the timers of of any disconnection that may be caused by vibration of equipment.

Develop Copper Without Impurities

PERFECTION of a new type of copper free from the usual impurities is announced by Phelps Dodge Copper Products Corp., New York. Basically of the oxygen-free type, it is made without melting from electrotylic cathode copper, which is plastically converted by tremendous pressure in a reducing atmosphere at elevated temperature into bars, rods, strip, or other desired commercial shapes. Hence the intrinsic purity of electrolytic copper is retained and even enhanced by the high temperature of the reducing gas. Outstanding characteristics of the new copper are greater conducting power, ductility, fatigue resistance and quality of the surface.

Contactors Embody Improvements

TWO improvements are embodied in the design of a new line of heavy duty contactors announced by Cutler-Hammer Inc., Milwaukee. Known as the 540 line of direct current contactors, they are available in 100, 150, 300, 600, 1200 and 1800 ampere sizes. First improvement is a high efficiency type arc blowout which quickly drives the arc from the contacts to the large arc horns above the contacts. The instantaneous rupturing of the arc on the arc horns, instead of on the contacts, prolongs contact life. Arc shields lift off for inspection, as the illustration shows. Design and construction of the electric interlock has also been improved. These contactors employ the usual Cutler-Hammer vertical contacts of pure silver, impervious to sulphur fumes and oxidation. Rollers which actuate the mechanism are plastic.

Series of direct current contactors is available in six sizes and features two improvements

Switch Uses Slow Break Principle

A SINGLE pole toggle switch with "snap-in" mounting is announced by The Hart Mfg. Co., Dept. D, Hartford, Conn., and employs the slow break principle which in conjunction with the large silver contacts, insures a positive, flickerless make and break. No screws are required for mounting it, as it has a spring lock

Eli Whitney exercised his inventive genius and foresight in developing the drive and controls for his milling machine. To a large extent they were makeshift but basically embodied many of the ideas now in use. Today design engineers have at their command an almost unlimited range of commercial drive and control units. The engineers' greatest problem lies in proper selection, a responsibility MACHINE DESIGN shares by bringing to its readers a Supplement devoted exclusively to this vital phase of design.

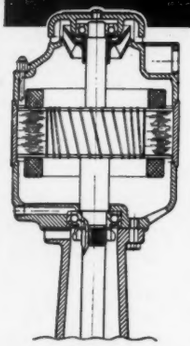
LET KENNAMETAL INCREASE YOUR RANGE
Of Machineable Steels

DESIGNERS need no longer compromise with production costs when a hard, strong steel is needed for a given machine part. For KENNAMETAL, the new hard carbide tool material, machines steel heat-treated up to 550 Brinell *at speeds comparable to those used in cutting much softer materials with high speed steel.* In addition, KENNAMETAL machines to closer tolerances, assuring accurate fitting parts, identical in size.

The McKenna engineer will gladly explain to you—and other executives in your plant—how KENNAMETAL can cut production costs . . . allow you greater freedom in specifying material for new machines. Send for him today.

McKENNA METALS Co.
146 LLOYD AVENUE
LATROBE, PENNSYLVANIA, U.S.A.

IT'S A "PIPE" TO INSTALL—*BECAUSE IT'S* PIPELESS



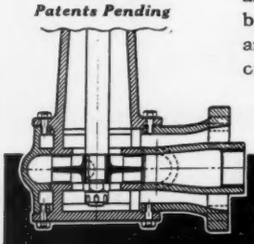
Gusher pipeless models—up to 200 G.P.M. really add beauty to the modern machines.

RUTHMAN
GUSHER
COOLANT PUMPS

are precision-built, noiseless, ball-bearing equipped, self-cleaning, will handle materials that contain grit and abrasives and have twin suction balanced intakes. Ruthman Gushers are all and more than you expect of the finest pumps.

Write for engineering data and specifications

Patented and Patents Pending



THE RUTHMAN MACHINERY CO.
540 E. FRONT ST., CINCINNATI, OHIO
LARGEST EXCLUSIVE BUILDERS OF COOLANT PUMPS

which permits the switch to be clipped into a panel or base. Housing of the switch is molded plastic. A compact convenience outlet has been designed in the same style as a companion piece.

Industrial Finish Announced

INCORPORATING a number of features desirable for finishing metal surfaces, a new industrial finish called No. 1 Chromelume has been announced by the Tousey Varnish Co., 520 West Twenty-fifth street, Chicago. A ready mixed aluminum finish, No. 1 Chromelume has these features: Extreme brilliance; air dries in 15 minutes; does not rub off after aging; covers approximately 2000 square feet of surface per gallon; will not settle or pack in containers; can be dipped, or flow coated; retains its elasticity and luster, and will not powder. Although the range of products on which No. 1 Chromelume may be used is large, it has proved very successful on machines and instruments.

Photoelastic Analysis in Commercial Practice

(*Continued from Page* 41)

and the equations then reduce to the following stress values.

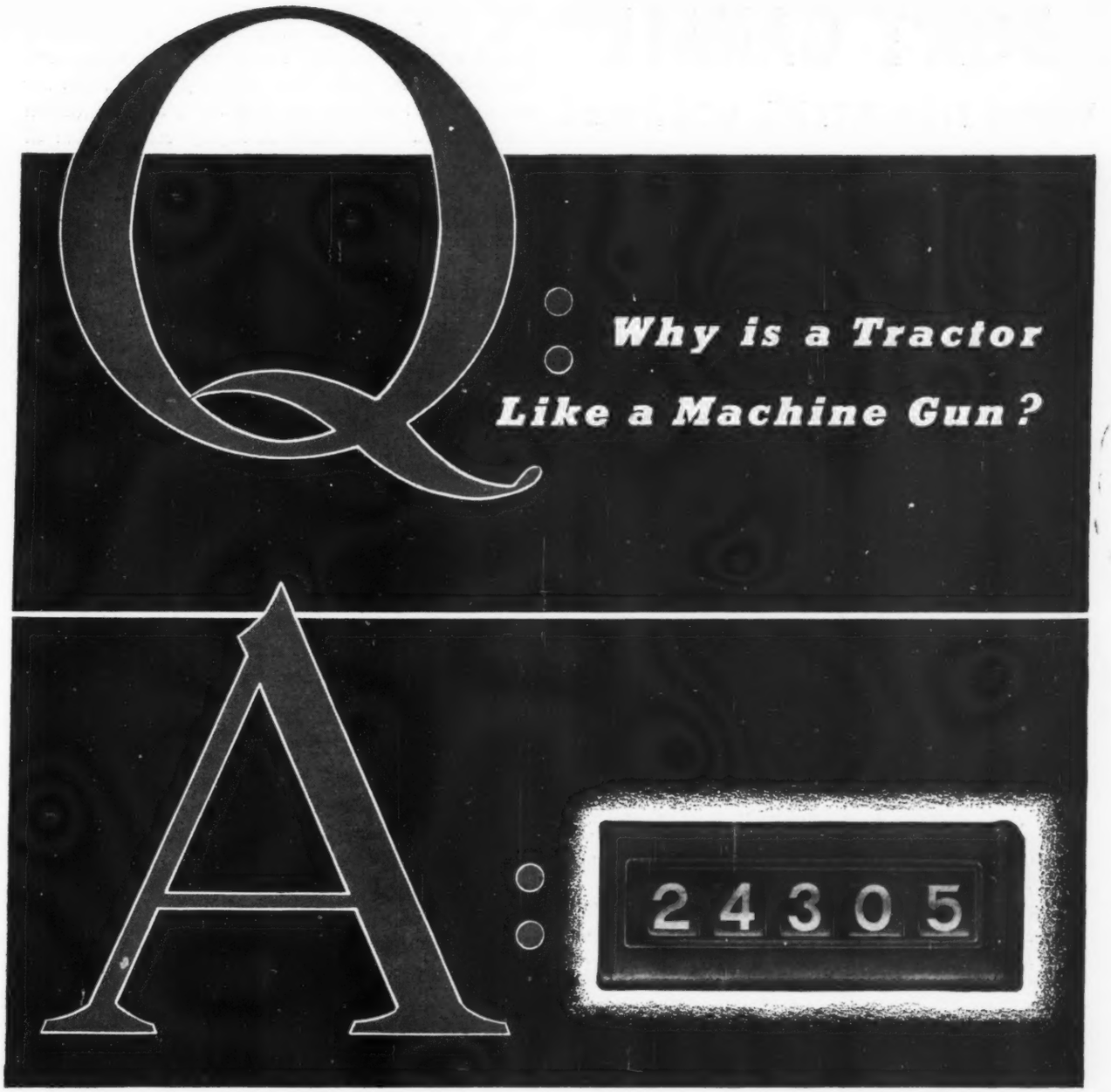
$$S_x = \pm Q \quad \ldots\ldots (17)$$

$$S_y = 0 \quad \ldots\ldots (18)$$

In the last two cases, (normal load only, or a free boundary), the principal directions are parallel and perpendicular to the boundary. The two possible inclinations of S_1 being 90 degrees apart, the plane polariscope cannot distinguish between them, and the correct one of the two solutions can not be selected as in the general case. However, there is seldom any difficulty in determining the proper solution. There will almost invariably be some point along the boundary where conventional knowledge, or elastic theory, will readily dictate the proper solution. From this point one may proceed along the boundary to the unknown point, remembering that sudden changes in the stresses may only be produced by boundary loads, the approximate local effect of which may be determined by elastic theory. Particularly in the case of a point on a free boundary is the proper solution obvious, as then it is a choice between tension or compression of the same value.

Apparatus Is Simple

From the above discussion it is apparent then, that the stresses along the entire boundary may be determined, and since failure begins at the boundary (except possibly contact stress), the strength of the part may be evalued from the photoelastic data, assisted only by the elements of elastic theory and con-



Tractors, machine guns, parking meters, pumps, bank vaults, looms, presses and hundreds of other machines have one thing in common—they have all profited through successful applications of built-in Veeder-Root Counting and Computing Devices.

In machines like these, Veeder-Root devices are used to compute sales, to count operations or pieces produced, to measure lengths or volumes, to record deposits, or to provide performance figures that mean so much to operators or plant managers.

Applications such as these make machines more useful, more reliable—and in many cases *more salable*. If you want to know more about it, simply read some of the success stories in our interesting booklet "Counting Devices", sent free to anyone who writes for it.

VEEDER-ROOT Inc.

HARTFORD, CONNECTICUT, U. S. A.

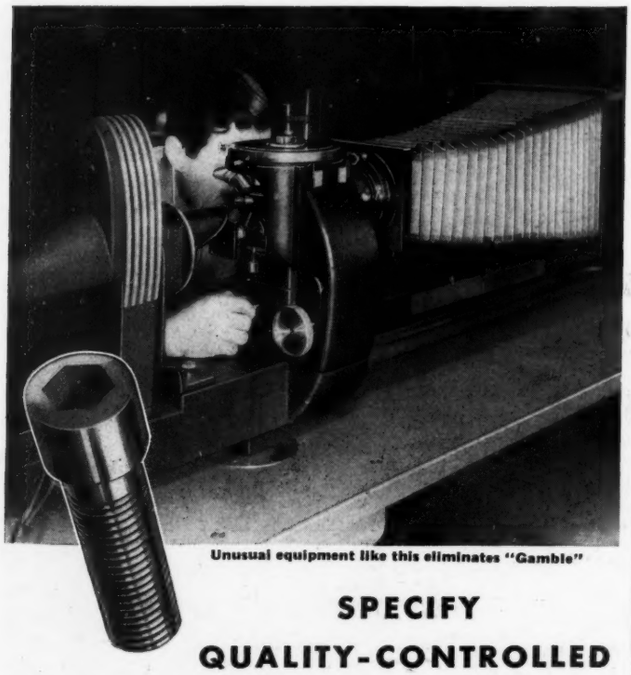
OFFICES IN Boston, Chicago, Cincinnati, Cleveland, Detroit, Greenville, S. C., Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Montreal, Buenos Aires, Mexico City, London, Paris, Tokio, Shanghai, Melbourne

IN ENGLAND: Veeder-Root Ltd., Croydon, Surrey

IN CANADA: Veeder-Root of Canada, Ltd., Montreal

DON'T GAMBLE

WITH DOUBTFUL SCREWS!



Unusual equipment like this eliminates "Gamble"

SPECIFY QUALITY-CONTROLLED PARKER-KALON SOCKET SCREWS!

It doesn't cost you a penny extra to use Parker-Kalon Socket Screws! And, you get unique protection against any "doubtful" screws . . . screws that might play hob with assembly efficiency, or fail in service.

Such protection has become available only since Parker-Kalon established a $250,000 laboratory to provide rigid quality control. Today, every Parker-Kalon Socket Screw is *bound* to measure-up in all characteristics after passing the 16 Parker-Kalon Quality-Control tests.

Tangible evidence of all this care is the Guarantee you get in every box. Order PARKER-KALON next time! For free samples and local distributor's name, write: Parker-Kalon Corp., 192-200 Varick Street, New York.

Quality-Controlled

16-point test and inspection routine covers: Chemical Analysis; Tensile and Torsional Strength; Ductility; Shock Resistance under Tension and Shear; Hardness; Head diameter, height and concentricity; Socket shape, size, depth and centriality; Class 3 Fit Threads; Clean-starting Threads.

PARKER-KALON
COLD-FORGED
Socket Screws

ventional knowledge of the subject.

In *Fig.* 10 is shown a polariscope and straining frame, representative of the most recent equipment. The lamp house contains a mercury vapor lamp for the light source. This emits a violet and a greenish yellow light. The latter is highly concentrated at 5461 *A. U.* Within the lamp house, is a filter to remove the violet light, leaving greenish yellow. A transformer supplies the proper voltage for the lamp. A condensing lens is used for bringing the light rays parallel. Next is a polarizing disk, rotatable in a graduated mount. Then, the first quarter wave plate, set also in a graduated mount, is hinged so that it may be swung out of position. This is followed by a second quarter wave plate and the analyzer, both identically mounted as the first two. Unit at the left is the projecting lens. These parts are mounted on a two piece optical bench with the straining frame interposed. A piece of white show cardboard serves admirably for a projecting screen.

Standard Parts Form Frame

Straining frame has a model in place. The frame is cold rolled bars and shapes. Loading is by means of a high grade spring balance. A standard surveyor's tension handle furnishes an excellent, compact, light weight unit. It reads to 30 pounds in ½-pound intervals. The balance is tensioned by a small turnbuckle.

A piece of 2-inch by .050-inch steel strip, with ½-inch of the compression edge flanged over, furnishes an effective and light weight beam for obtaining higher loads than obtainable directly from the balance. Pivots should be small compared to center distances to keep the friction low.

Loads may be applied to holes in model by means of steel bushings through which are passed small steel pins. In the case illustrated the externally applied loads were distributed over the required width of approximately 1/16-inch by means of ⅛-inch cold drawn hexes. The loading is through .020-inch dia. music wire. The hangers are ½-inch × .020-inch strip steel.

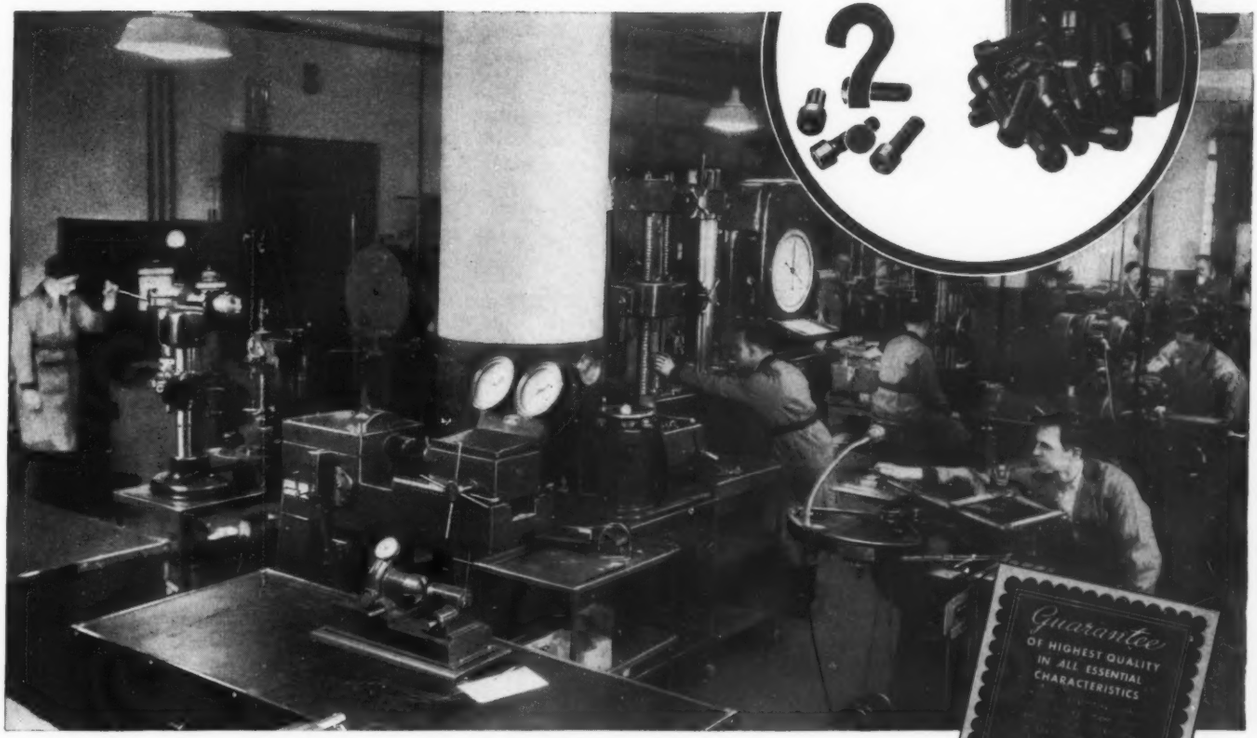
A camera is necessary for permanent records. As the projecting lens serves as the camera lens it is only necessary to provide a long box reaching to somewhere near the lens, in order to eliminate stray light. Built of plywood it may be arranged to accept a standard film pack holder. The focusing screen is best made from a piece of cellulose acetate sheet held in a light wooden frame. It must have its rough face at exactly the position the film takes. A piece of cardboard to cover the front opening is all that is required for a shutter.

EDITOR'S NOTE: The first sentence, second paragraph of this article on Page 39 should read: *Elastic theory recognizes that the principal stresses, S_1, S_2, and their directions, or the stresses in the X and Y directions, S_x, S_y, and v_{xy}, are sufficient to determine the state of stress at any point in a body under plane stress.*

(CONTINUED IN NEXT ISSUE)

NO *Doubtful Few*

To "Gum-Up" Fastening Jobs



. . . When Parker-Kalon's Quality-Control Laboratory guarantees fastening devices

EVEN a few imperfect screws in a box can "gum-up" assembly work . . . waste time, boost costs, fail to make satisfactory fastenings. That's why thousands of plants specify Parker-Kalon and avoid all troubles caused by the "Doubtful Few."

Parker-Kalon Fastening Devices are made to standards that permit no "Doubtful Few"... standards that could only be attained when Parker-Kalon established a $250,000 Quality-Control Laboratory. Without counterpart in the industry, this laboratory applies a unique scientific control-routine to insure that Parker-Kalon Fastening Devices always work right and hold tight.

It pays to buy Hardened Self-tapping Screws, Socket Screws and other fastening devices that are made in the most modern plant in the screw industry. Parker-Kalon Corp., 192-200 Varick St., New York.

COSTS NO MORE *to get this Parker-Kalon Quality-Control Guarantee with every box of . . . .*

Hardened Self-tapping Screws
Types, sizes, head-styles for every assembly of metal or plastics

Cold-forged Socket Screws
Cap Screws, Set Screws, Stripper Bolts made to a new high standard of quality

Wing Nuts-Cap Nuts-Thumb Screws
Cold-forged . . Neater, Stronger

SOLD ONLY THROUGH RECOGNIZED DISTRIBUTORS

Quality-Controlled **PARKER-KALON Fastening Devices**

A New Line . . .
the 500 Series ROTARY GEARED PUMPS
with HERRINGBONE GEARS

—Quiet in operation
••• for pressures up to 500 lbs.
Ask for circular
Brown & Sharpe Mfg. Co.,
Providence, R. I., U. S. A.

BROWN & SHARPE
B·S PUMPS

Blue DEVIL
The ARISTOCRAT of SOCKET SCREWS

1 — Cold-formed heads — unimpaired continuity of fibres.
2 — Tensile strength 215-225,000 lbs. sq. in.
Try our service on your special sizes.
3—Precision formed hexagon socket with true sides and no taper.
4—Chamfered edge knurled to facilitate assembly.
Blue Devil Cap Screws are unbelievably tough, and are heat treated in electrically controlled furnaces. Send for catalogue and samples.

Nothing too large - Nothing too small for
SAFETY SOCKET SCREW CORPORATION
4447 N. KNOX AVE., CHICAGO, ILLINOIS

Business and Sales Briefs

PLANS are under way by Square D Co. to construct and equip a one-story factory building in Milwaukee in order that production of electrical control apparatus may be transferred to the new plant when completed.

♦

Appointment of E. J. Ehret and J. D. Kinsey, with offices at 307 South La Salle street, Chicago, has been announced by John Waldron Corp., New Brunswick, N. J. The new sales representatives will handle the company's complete line of gear type and flexible couplings in the Chicago territory.

♦

Diamond Chain & Mfg. Co., Indianapolis, has recently celebrated its fiftieth anniversary and has adopted as its slogan "Fifty years of doing one job well!"

♦

E. K. Anderson, with Cutler-Hammer Inc. for a number of years, has been appointed manager of the company's branch office at Dallas, Texas. This office covers the territory of Arkansas, Texas, Oklahoma and southern part of New Mexico. Location is 624 Santa Fe building, Dallas.

♦

Recent appointment of D. S. Kerr as manager of Allis-Chalmers Mfg. Co. branch office at Atlanta has been announced. As manager of this office Mr. Kerr will have both the Chattanooga and Knoxville, Tenn. offices under his jurisdiction.

♦

Election of William A. Barr as president was announced by Foote Bros. Gear & Machine Corp., Chicago. Since November, 1939, Mr. Barr has been executive vice president and general manager, and previous to then for eight years was vice president in charge of manufacturing.

♦

In addition to his regular southwest area which he has covered for some time, Lee Raley, Dallas, Texas, will represent the McGill Mfg. Co., Valparaiso, Ind., in Colorado, Utah, New Mexico and Wyoming.

♦

After twenty-three years with The Timken Roller Bearing Co., William H. Richardson has been appointed assistant general sales manager. Mr. Richardson was formerly general manager of the service-sales division, and previous to that served in various capacities, first as a salesman and later as branch manager, district manager, and as vice president and general manager of the old Timken Roller Bearing Service & Sales Co.

♦

Besides United Aircraft Corp., East Hartford, Conn., and Wright Aeronautical Corp., Paterson, N. J., Aircraft Screw Products Co. Inc., 25 Forty-first avenue, Long Island City, New York, has licensed the following companies: Air Associates Inc., Garden City, N. Y., to the Aircraft Aero-Thread screw system in the aircraft industry; and the Chicago Screw Co., Chicago;

More New
HIGHS

MACHINE DESIGN finishes the first four months of 1940 with a substantial increase in advertising pages over the same period last year. The month-to-month gains in advertising volume testify to a continuously expanding list of companies finding MACHINE DESIGN an effective and indispensable advertising medium.

	1940 Pages	1939 Pages
January	64	43
February	65	52
March	64	48
April	103	92

MACHINES . . .

of all types and sizes are designed by readers of Machine Design.

THIS FIELD EMBODIES:

Adding machines
Addressing & mailing machines
Agricultural machinery
Air conditioning equipment
Aircraft (airplanes, seaplanes & amphibians)
Automobiles

Bakery machinery & equipment
Baling presses
Blowers & fans
Blueprinting & drafting machines
Bookbinding machinery
Bottling machinery

Calculating & counting machines
Cameras (including motion picture) & projectors
Canning machinery
Card-punching, sorting & tabulating machines
Cars & trucks, industrial & mining
Cash registers
Cement & concrete machinery
Centrifuges—separators
Change-making machines, taxi meters and ticket-counting machines
Check-writing machines
Chemical machinery
Clay-working machinery, brick, pottery, etc.
Clocks, time recorders & watches
Clothes-pressing machines
Coffee-roasting & grinding machines
Coin-operated machines
Condensers, other than electrical
Confectionery & ice-cream machinery
Conveying machinery including elevators and escalators
Cotton ginning machinery
Cranes, including hoists & derricks
Crushing, grinding & pulverizing machinery

Dairy, cheese factory & butter factory machinery
Dental machinery
Diesel engines
Dish-washing machinery
Dredging & excavating machinery including power shovels
Duplicating machines

Electric motors & generators
Electric & pneumatic portable tools
Electric razors and hair clippers
Electrical equipment (instruments controls, relays, etc.)
Elevators (storage) & elevator machinery, including grain, flour & feed
Engines, steam & internal combustion

Fare registers & boxes
Firearms
Flour-mill & grain-mill machinery
Foundry machinery

Gas machines
Gas regulators
Glass-making machinery
Grinding, buffing & polishing mchy.

Hat-making machinery
Hydraulic equipment, incl. pumps

Incandescent lamp-making machinery
Industrial ovens & electric furnaces
Inspection machinery

Kitchen mixers & allied domestic machines not otherwise classified

Labelling machinery
Laundry and dry cleaning machinery
Lawn mowers
Leather-working machinery not including shoe machinery
Locomotives, rail cars, etc.
Lubricating machines

Machine tools
Metalworking machinery
Meters, gas & water
Mining machinery, not incl. oil drilling
Miscellaneous (not classified elsewhere)
Motorcycles & bicycles
Motor vehicles, except motorcycles
Musical instruments

Oil burning equipment
Oil-mill machinery, cottonseed & other
Oil-well & oil refinery machinery
Optical machinery incl. telescopes, microscopes, etc.
Orecrushers

Packaging machines
Packing-house machinery
Paint making machinery
Paper-box machinery
Paper-mill & pulp-mill machinery
Permanent wave machines, hair-dryers etc.
Pharmaceutical machinery
Photo-engraving machinery
Plastics molding machinery, including presses & accessory equipment
Pneumatic equipment, including compressors
Power presses, including hydraulic & forging hammers
Printers' machinery
Pumps & pumping equipment

Radios & television
Recording and control instruments, including pressure & temperature indicators
Refrigerating & ice machinery
Research equipment, including testing, balancing & precision measuring machines
Road-making machinery, other than concrete mixers
Rolling-mill machinery
Rubber working machinery

Scales & balances
Sewing machines
Ships & motorboats
Shoe machinery
Signs, advertising & electrical
Slicing machinery
Special machinery
Stapling & wire stitching machinery
Stokers, domestic & industrial
Stone-working machinery
Sugar-mill machinery

Textile machinery
Tobacco manufacturing machinery
Toys, amusement machines & playground equipment
Transmission machinery
Turbines
Typewriters

Vacuum cleaners

Washing machines & clothes wringers
Welding machines, electric & other
Well-drilling machinery
Windmills & towers
Woodworking machinery

X-ray, therapeutic & hospital

Hartford Machine Screw Co., Hartford, Conn.; and Western Automatic Machine Screw Co., Elyria, O. for industry in general.

♦

Frank E. Graper has been appointed president and general manager of Acklin Stamping Co., Toledo. F. Cyril Greenhill is vice president and general sales manager.

♦

A new building upon foundations which ultimately could support an 8-story addition to the company's present production facilities is being planned by Allen-Bradley Co., Milwaukee.

♦

William Brand & Co. has established its own manufacturing plant at Willimantic, Conn., for the production of saturated sleeving and flexible varnished tubing.

♦

Work on a new plant solely for the manufacture of an extensive line of self-locking nuts has been begun by Elastic Stop Nut Corp. The plant will be located on Vauxhall road, Union, N. J., a suburb of Newark. Transfer of the present plant at Elizabeth, N. J., it is expected, will take place about June 1 this year.

♦

According to a recent announcement Congress drives and die castings will be manufactured at the new modern plant at 3750 East Outer Drive at Mt. Elliott, Detroit. The company will be known as the Congress Die Casting division of Congress Tool & Die Co.

♦

With offices located at 4905 South Santa Fe avenue, Los Angeles, W. L. Kennicott has been appointed representative in Southern California for McKenna Metals Co., Latrobe, Pa.

♦

Edward S. Perot has been made president of Crocker-Wheeler Electric Mfg. Co., Ampere, N. J. Mr. Perot joined the company early in 1939 as executive vice president, and was elected to the directorate in the latter part of June.

♦

Previously in charge of the New York office of Lukens Steel Co., Coatesville, Pa., George L. Gordon has been transferred to Coatesville where he will be engaged in special sales work. J. J. Reynolds, sales representative in the New York office for the past 13 years, has been appointed manager of sales at New York.

♦

Felix A. Redlich has been appointed New York representative of Columbus Plastics Products Inc., Columbus, O. Mr. Redlich's headquarters will be at 475 Fifth avenue.

♦

Formerly New England sales manager for Wheelock Lovejoy Co., Cambridge, Mass., Arden L. Knight has joined the sales force of Latrobe Electric Steel Co., Latrobe, Pa.

♦

Appointment of F. B. Cornell and C. H. Knappenberger as agents in the state of Michigan has been made by Duraloy Co., Scottdale, Pa. The new agency will be known as Duraloy Co. of Detroit, with offices at 1124 Ford building, Detroit.

♦

Warren R. Eaton has been elected vice president of

DO YOU USE STRESS PARTS?

If so, consult Kropp's Drop Forge Dept.

Kropp makes hundreds of types of machine, equipment and automotive parts exposed to stresses for manufacturers everywhere. Our drop hammer men are experts. No matter how intricate, how small or how large, Kropp makes a better drop forging—12 drop hammers, complete die shop and consultation service.

Drop Forgings eliminate breakage of stressed parts, reduce replacement costs, and will enhance or protect the good name of your product. In many cases, they save over cast or fabricated parts.

Write for Bulletin showing our complete steam hammer, drop and upset forging and machine facilities and name of our nearest representative.

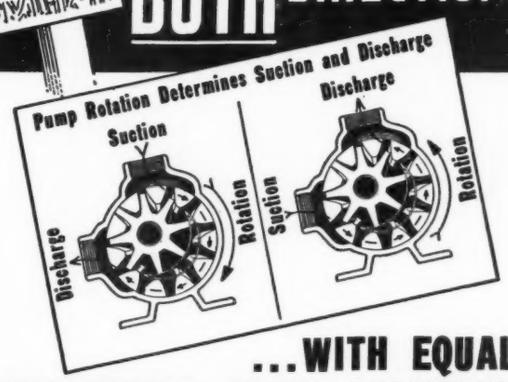
KROPP FORGE COMPANY

America's Largest Job Forging Shop

5307 W. ROOSEVELT ROAD, CHICAGO, ILLINOIS

Representatives in Principal Cities

VIKING ROTATES IN BOTH DIRECTIONS



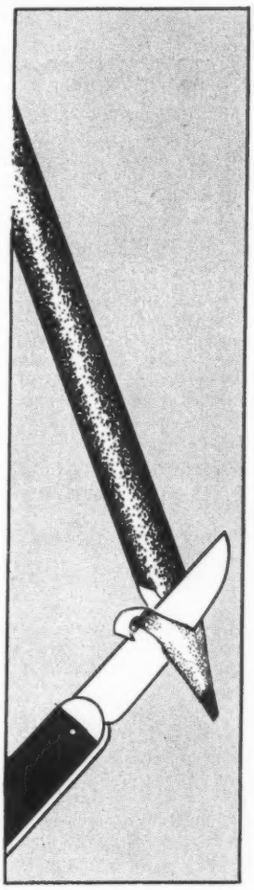
...WITH EQUAL EFFICIENCY! EQUAL ACCURACY

You merely reverse rotation of pump shaft to reverse flow of liquid in the Viking Rotary Pump. Figure at left shows pump with TOP SUCTION and SIDE DISCHARGE . . . at right, after reversing, SIDE SUCTION and TOP DISCHARGE. Simple and practical isn't it? And it's another real reason why Viking Pumps are selected by all leading machinery manufacturers. Write for Bulletin 1802-35 and check all the other profitable Viking features.

VIKING PUMP CO.

CEDAR FALLS, IOWA.

LET'S SHARPEN OUR PENCILS to figure the cost of SPRINGS!



LET'S get to the heart of this subject of spring costs and see how Accurate Springs can save you money in the long run. Sharpen your pencil and put these items down:

1. **First Cost**—The Accurate plant is set up in such a manner that the cost of precision production and close inspection of even the most complicated and special springs is held to a minimum—you profit because of this.

2. **Assembly Time Cost**—Accurate Springs are accurate—they'll clear your inspection department quickly and pass on to the production lines without costly delay, without holding up assembling operations.

3. **Delayed Delivery Costs**—When your production is geared to meet your own delivery dates, it costs you money if you don't get needed parts on time. Accurate acknowledges and gives you shipping dates on rush orders so that you can plan your production accordingly.

Don't forget to figure all of these hidden items when you figure the cost of springs. Then you'll see why Accurate quality and service bring you savings in the long run. Write for information today.

FREE HANDBOOK

Write today for your copy of Accurate's useful handbook of otherwise hard-to-find spring data. It's compact and informative.

Accurate Springs

ACCURATE SPRING MFG. CO.

3813 W. Lake Street **Chicago, Ill.**

LEADERSHIP!

for temperature control—

"TOASTMASTER" *depends on* WILCO

Puzzled over the proper contact materials for your product? Then do as the McGraw Electric Co. — Maker of "Toastmaster" Products — and thousands of other industrial leaders do. Consult with Wilco — pioneer in the development of scores of varying contact materials.

Benefit from 26 years of experience in the research, manufacture and sale of every known kind of electrical contact. Utilize products that have *proved* their accuracy and reliability under every conceivable kind of laboratory and field test. Write for "Wilco Blue Book of Thermometals"—The H. A. Wilson Co., 105 Chestnut Street, Newark, N. J. Branch Off.: Detroit, Mich., & Chicago, Ill.

WILCO ELECTRICAL CONTACTS

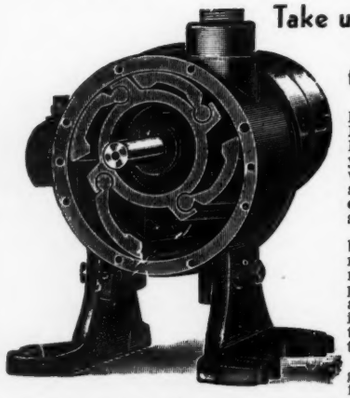
PLATINUM . . . IRIDIUM . . . SILVER . . . INLAY . . . OVERLAY . . . LAMINATED . . . TUNGSTEN

LEIMAN BROS. Patented Rotary Positive

AIR PUMPS

Pressure—Vacuum Gas Pumping

AIR MOTORS



Take up their own wear
No packing or tips on the wings

The built-in one-year-lubrication of Leiman Bros. Rotary Positive Air Pumps is the new wool yarn packed bearing which holds in suspension enough lubricating oil for one year's service strained and purified.

The continuous unbroken cylinder surface makes these always noiseless air and gas pumps doubly quiet. The air enters and emerges in a sidewise course through the by-pass in the cylinder head side.

This means a smooth, glassy-like cylinder surface, easy operation and saving in power.

The advantage gained by this simple construction is that the wings in constant operation will wear in conformity with the inner cylinder wall and become smooth and glassy like as well as case hardened in use, and maintain a perfect fit and positive air pressure, even after long continued usage.

Get Free Information No. P3D.

LEIMAN BROS. 23 (P3D) Walker St. NEW YORK CITY

Makers of good machinery for 50 years

Bliss & Laughlin Inc., Harvey, Ill.

♦

Herman W. Falk, founder of the Falk Corp., Milwaukee, and president since its inception, has become chairman of the board and is succeeded by Harold S. Falk as president.

♦

Formerly engaged in sales-engineering work in the centrifugal pump division of Allis-Chalmers Mfg. Co., Milwaukee, H. P. Binder has been named assistant manager of that division.

♦

The Candler-Hill Corp., 2200 Eighth street, Detroit, has recently been formed to manufacture fuel pumps of its own design for military and transport aircraft engines and for stationary and automotive diesel engines. Boyer Candler, former assistant treasurer of Burroughs Adding Machine Co., and Edward J. Hill, previously vice president of Chandler-Evans Corp., are the organizers.

♦

Previously connected with the Steel & Tube division of The Timken Roller Bearing Co., Sidney D. Williams has joined Copperweld Steel Co. as vice president in charge of sales for the company's new steel division at Warren, O.

♦

Having been assistant to general manager of sales, Vanadium Corp. of America, New York, for the past year, John W. Lohnes has been appointed assistant general manager of sales of the company. Mr. Lohnes previously had been connected with the corporation's Chicago Office. Transferring of Donald C. Hostettler, eastern sales representative, to take charge of the Detroit district sales office, succeeding J. Berens Waters, who is assuming duties of general purchasing agent, is also announced. John B. Girdler has been made eastern representative to succeed Mr. Hostettler.

♦

Colman Curtiss Jr. has recently been appointed as assistant to A. M. Jones, general sales manager, of Buffalo Bolt Co., North Tonawanda, N. Y. Mr. Curtiss has been identified with the company since 1934.

♦

Former sales manager of Consolidated Molded Products Corp., Scranton, Pa., R. H. Allen has resigned from the company.

♦

Since 1929 vice president in charge of castings sales of Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., R. A. Cannon has been appointed vice president in charge of general sales.

♦

Appointments recently made by Air Reduction Sales Co., include the following: D. F. McCandlish, formerly manager of the Oklahoma City district, as manager of the Detroit district; and G. J. Dekker, previously assistant manager of the Detroit district, as manager of the Oklahoma district.

A 21 inch diameter card index wheel weighing 10 lbs. or a ¼ inch diameter adjuster bushing,—smaller than a kernel of corn—and weighing only 1/40 of an ounce are both good Plastic Molded applications.

So versatile are plastics that they are adaptable to countless applications which improve a product and lower its production costs.

Our engineering staff will cooperate with you on your plastic molding problems.

CHICAGO MOLDED PRODUCTS CORP.
1028 No. Kolmar Ave. CHICAGO, ILLINOIS

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by Thomas C. McFarland 4.00
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Fractional Horsepower Electric Motors
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by Geo. H. Hall 3.00
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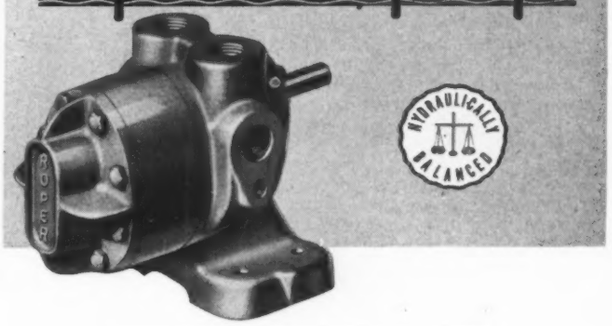
MACHINE DESIGN

Penton Building Cleveland, Ohio

A *New* IMPROVED LINE OF
ROPER *Rotary* PUMPS



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CAPACITIES	1 to 1800 G. P. M.
PRESSURES	Up to 1800 lbs. per sq. inch
MOUNTINGS AND DRIVES	21 Different Types to meet your requirements
SPEEDS	Up to 1800 R. P. M.
BEARINGS	Sleeve or Roller Bearings
PACKING BOXES	Three different types
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PIPING	Eight arrangements

Write for the New
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Catalog "932"

with illustrations, cutaway views, drawings, dimension and pumping capacity tables, and complete information on the new improved Roper line.

GEO. D. ROPER CORP. ROCKFORD, ILLINOIS

NEW MACHINES—
And the Companies Behind Them

(For illustrations of other outstanding machinery see Pages 40-41)

Air Conditioning

Gas-fired conditioners, Conco Corp., Mendota, Ill.
Stoker, Holcomb & Hoke Mfg. Co., Indianapolis.
Window fan, Viking Air Conditioning Corp., Cleveland.

Bottling

Rotary bottle cleaner, The Karl Kiefer Machine Co., Cincinnati.
Cotton wadding machine, Consolidated Packing Machinery Corp., Buffalo, N. Y.
Mixer, Miller Hydro Co., Bainbridge, Ga.

Domestic

Doctor's type scale, Detecto Scales Inc., Brooklyn, N. Y.
Scale, The Bearley Co., Rockford, Ill.
Electric dual close shaver, General Shaver Div., Remington Rand Inc., Bridgeport, Conn.
Electric clock, Sessions Clock Co., Forestville, Conn.
Floor machine, The Regina Corp., Rahway, N. J.

Dry Cleaning

Commercial rug beaters, United Vacuum Appliance Corp., Connersville, Ind.

Metalworking

Four-spindle precision boring machine, Moline Tool Co., Moline, Ill.
Heavy-duty oil groover, Wicaco Machine Corp., Philadelphia.
Oil pump body machine, Greenlee Brothers & Co., Rockford, Ill.
Motor-driven threading machine, Rickert-Shafer Co., Erie, Pa.
Power press, Contract Engineering Co., Cleveland.
Grinder, Stanley Electric Tool Div., New Britain, Conn.
Rolling mill, Farrel-Birmingham Co. Inc., Ansonia, Conn.
Hydraulic shaper, Rockford Machine Tool Co., Rockford, Ill.
Hammer, Chambersburg Engineering Co. Inc., Chambersburg, Pa.
Surface broaching machine, Oilgear Co., Milwaukee.
Hob sharpening machine, Barber-Colman Co., Rockford, Ill.

Mining

Powered centrifugal pumps, Allis-Chalmers Mfg. Co., Milwaukee.

Models

Model engine, Feeney Engine Co., Chicago.

Office

Amplicall system, Webster-Chicago Co., Chicago.
Post card duplicator, The Orthograph Co., Los Angeles.

Packaging

Cake wrapping machine, The Battle Creek Bread Wrapping Machine Co., Battle Creek, Mich.
Machine for filling two separate ingredients, Triangle Package Machinery Co., Chicago.
Capping machine, Crown Cork & Seal Co., Philadelphia.
Automatic bag making unit, Modern Containers Inc., Los Angeles.
Tube filler, Commercial Filters Corp., Boston.

Printing

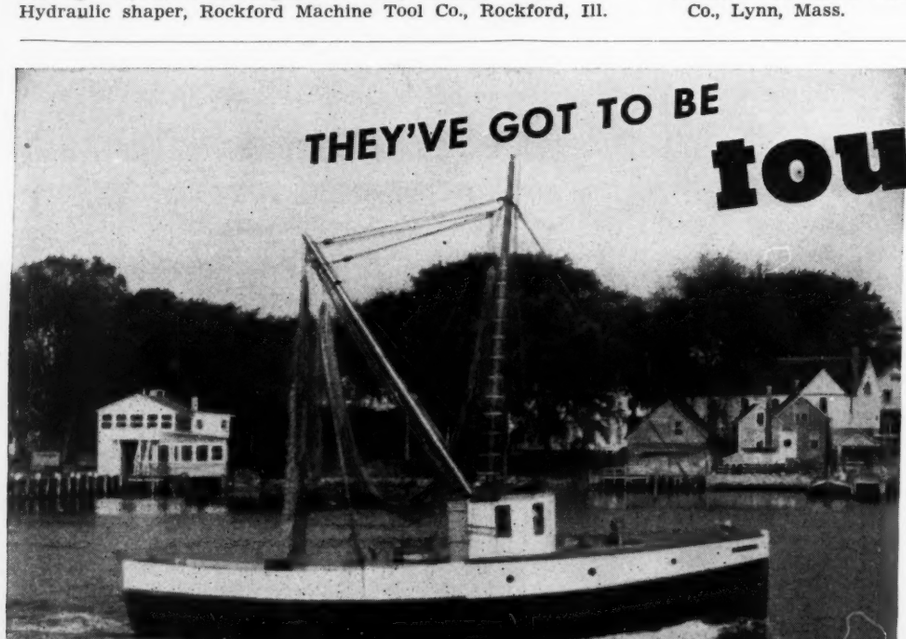
Continuous stream feeder, Christensen Machine Co., Racine, Wis.
Small proof press, Challenge Machinery Co., Grand Haven, Mich.

Restaurant

Two-rack electric dishwashers, Edison General Electric Co., Chicago.
Electric mixer, Landers, Frary & Clark, New Britain, Conn.
Ice cream freezer, Taylor Freezer Co., Beloit, Wis.
Drinkmaster mixer, Hamilton Beach Co., Racine, Wis.
Automatic cashier, Johnson Fare Box Co., Chicago.

Welding

Arc welders, K. O. Lee & Son Co., Aberdeen, S. D.
Precision controlled welder, Thomson-Gibb Electric Welding Co., Lynn, Mass.



THEY'VE GOT TO BE **tough** TO TAKE IT

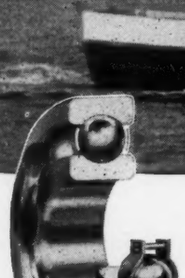
"Roberta A", 35-foot trawler owned by Capt. Lawrence Ashcroft, Noank, Conn., powered by a Lathrop Type D-50, Full Diesel Marine Engine, equipped with BCA Annular Ball Bearings.

The pounding Lathrop Diesels get in fishing boats like this calls for ruggedness to match the hardy stamina of the men who sail them.

When Lathrop specifies and uses BCA Annular Ball Bearings in their Diesel Marine Engines they pin a medal on BCAs which is more eloquent than anything we could say. For it means that Lathrop knows that BCAs can "take it" too.

If you've got a tough assignment for ball bearings—if you're building machines which must run smoothly and cool under any and all service conditions—we'd like to talk to you about ball bearings.

BEARINGS COMPANY OF AMERICA, LANCASTER, PENNA.



BCA Annular Ball Bearing, Maximum type, as supplied to the Lathrop Engine Company, Mystic, Conn., for use in their Diesel Marine Engines.

BCA RADIAL • ANGULAR CONTACT • THRUST BALL BEARINGS